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Volume 2 Number 1

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ABSORPTION AND SCATTERING OF RADIATION

1 Angular Correlation of Successive Gamma-Ray Quanta II by Edward L Brady and Martin Deutsch Phys Rev 74 1541-1542 (1948) Nov 15 (Letter to the editor)

The angular correlation of successive gamma-ray quanta emitted by the product nuclei Ni^{60}, Ti^{46}, Mg^{24}, Ba^{134}, Sr^{88}, and Pd^{106} of the isotopes Co^{60}, Na^{24}, Sc^{46}, Cs^{134}, Y^{88}, and Rh^{106}, respectively, has been determined. The use of Kallmann scintillation counters has resulted in approximately a tenfold gain in efficiency over the G-M counters previously used (Phys Rev 72, p870 (1947)). The product nuclei mentioned are all of even-even type and presumably have J = 0 in the ground state. Experimental results obtained for the Co, Na, Sc, and Cs isotopes investigated are consistent with two quadrupole quanta and J values of 4, 2, and 0. The distribution for Y^{88} is best explained by interference between electric and magnetic radiations. Both rays of Rh^{106} must be at least quadrupole and the first excited state of Pd^{106} must have a J value of at least 2. The assignment of the J values to Pd^{106} is important since Peacock (Phys Rev 72, p 1049 (1947)) has based a strong argument for the validity of the Gamow-Teller selection rules on evidence that the second excited state does not have J = 0.

2 Angular Distribution in Internal Pair Creation by G K Horton Proc Phys Soc 60 457-460 (1948) May 1

If, in a nuclear process, gamma rays are emitted with an energy exceeding one million electron volts, electron-positron pairs may be created in the field of the emitting nucleus. The process is exactly analogous to internal conversion with the creation of a pair replacing the ejection of an atomic electron. It is shown that the statistics of the angles between the directions of the electron and positron emitted in internal pair creation provides a method of distinguishing between the different types of transition without requiring the comparison between counts of gamma quanta and electrons. Magnetic dipole radiation is indistinguishable from electric quadrupole radiation by this method and they are in any case likely to appear mixed in a nuclear transition.

This method offers an alternative to the well known procedure in which the ratios of the conversion coefficients from the K, L...etc. shells are used. At higher energies where the method here proposed becomes applicable, such a procedure may become difficult as then the conversion electrons from different shells differ relatively little in energy. Curves are presented which show the overall angular distribution of pairs and the probability for a given energy distribution with $\gamma = 3$ and with $\gamma = 5$.

3 Anomalous Absorption of RaC Gamma-Rays by P K Sen Chaudhary Indian J Phys 22 341-346 (1948) Aug

The absorption coefficient of RaC gamma rays passing through 19-27 cm of lead was measured using a Geiger-Müller counter. The counter was shielded with 1 cm of lead and placed vertically above the source at a distance of 45 cm. The value obtained for the absorption coefficient using 19-20 cm of lead was 0.456 ± 0.04 per cm, which corresponds closely with the accepted value. However, between 22.23 and 24.77 cm of lead the coefficient decreased to 0.31 per cm, which is far below the theoretical minimum of 0.47 per cm. The value of the coefficient then returned to a higher value between 24.2 and 27 cm. Possible explanations advanced to explain the anomaly are: 1) some meson type of radiation, such as electron-positron pairs behaving as neutrettos before annihilation which might be emitted by the RaC, 2) multiple scattering in the forewaŗd direction. Tabulated data are given for number of counts, intensity, and absorption coefficient as functions of lead plate thickness.

4 A Boundary Value Condition for Proton-Proton Scattering by G Breit and W G Bouricius Phys Rev 74 1546-1547 (1948) Nov 15 (Letter to the editor)

The interpretation of the ^1S state phase shift derived from proton-proton scattering experiments of numerous investigators by means of a boundary condition requirement rather than a potential energy curve description is discussed. Such a boundary condition in the extreme case would suggest that the shape of the wave function of the protons in the part of configuration space in which dissociation becomes definite is affected mainly by factors other than the kinetic energy of relative motion at a large distance.

ABSORPTION AND SCATTERING OF RADIATION (continued)

5 Bremsstrahlung in Electron Collisions by E M Lifshitz Zhur Eksptl i Teoret Fiz 18 562-565 (1948) June (In Russian)

The problem of the exact calculation of the effective cross section of the bremsstrahlung in electron collisions has not yet been solved. The calculation can be made, with logarithmic approximation, for the extreme relativistic case, the result coinciding with Bethe-Heitler's formula for the collision of a rapid electron with a nucleus Z = 1 (The Quantum Theory of Radiation by Heitler. 2nd ed Oxford, 1944). The present author gives a solution for the non-relativistic quantic case, in which the collision velocity v is much smaller than the light velocity, yet too high to satisfy the classic equation, i.e., when $c \gg v \gg 2\pi e^2/h$. The results are: (1) a formula for the spectral distribution of the radiation, where $d\sigma_\omega$ is given as a function of the frequency and the initial energy E_0 of the relative movement of the electrons; and (2) a formula giving $d\varkappa$, i.e., the angular distribution of the total radiation; the quantity $\varkappa$ characterizing the total radiation is found to be $\varkappa = (80/9)\alpha r_0^2 E_0$, (where $\alpha = 2\pi e^2/hc$ and $r_0 = e^2/mc^2$), whereas the corresponding classical expression (i.e., for $2\pi e^2/hv \gg 1$) is $\varkappa = (64\pi/3)r_0^2 E_0 (E_0/mc^2)1/2$.

6 Broad and Narrow Beam Attenuation of 500-1400 Kv X-Rays in Lead and Concrete by H O Wyckoff, R.J Kennedy and W R Bradford Nucleonics 5, 62-70 (1948) Nov

In this report on x-ray shielding investigations and the use of attenuation curves in designing x-ray protection the following conclusions are reached. Because of the small irradiated areas required for broad beam conditions in lead, the broad beam attenuation curves should be used for nearly all cases where lead barriers are considered in this voltage range. The extra thickness of lead required for broad beam conditions over that for narrow beam varies rapidly with x-ray tube potential. This extra thickness requirement varies from approximately 10% at 500 kv to 25% at 1400 kv. For concrete protective barriers the difference between narrow and broad beam thickness requirements is of the order of 1.5 to 2 half-value layers depending upon the portion and kilovoltage of the curves considered. If the irradiated area of the barrier is not more than 3 feet in diameter and if all personnel are restricted to distances larger than 10 feet from the barrier, then narrow beam attenuation curves may be used in designing x-ray protection. Such restrictions are not usually feasible, however, because of space limitations. In addition, the cost of requiring the extra space may be larger than the saving in barrier cost. For the majority of x-ray installation designs, therefore, the broad beam attenuation curves should be used. 5 references and 7 figures.

7 Correlation between Direction and Polarization of Successive Gamma-Ray Quanta by Martin Deutsch and Franz Metzger Phys Rev 74 1542-1543 (1948) Nov 15 (Letter to the editor)

An experimental determination of the correlation between the polarization of one quantum and the direction of emission of the other, for two successive gamma rays, has been made using a coincidence polarimeter consisting of three Kallmann counters. The method was tested using Co^{60} and Cs^{134} gamma rays scattered through 90° by an aluminum scatterer. Data were taken for single counts, double coincidences, and triple coincidences, for various counter positions (i.e., rotation of the contained naphthalene crystals) which were correlated with polarization of the quanta. Significant results obtained using Rh^{106} gamma rays are shown and compared with the theoretical curve obtained using Hamilton's calculation (Phys Rev 74 782 (1948)) and assuming both quanta are electric quadrupole. The results obtained indicate that the parity of the second excited state of Pd^{106} is the same as that of the ground state.

8 Inelastic Scattering of Protons from Light Nuclei by H W Fulbright and R R Bush Phys Rev 74 1323-1329 (1948) Nov 15

A method has been developed for doing scattering experiments inside the vacuum chamber of an f-m cyclotron. The magnetic field of the cyclotron is used to analyze the scattered beam. The spectrum of the scattered particles is recorded on photographic plates, and lines corresponding to states of the scattering nucleus are found. The energy levels obtained for B, C^{12}, N^{14}, O^{16}, Mg, Al^{27}, and Ni are given. Photographs and energy plots are included for some of the scattering experiments

ABSORPTION AND SCATTERING OF RADIATION (continued)

9 The Influence of an Homogenous and Longitudinal Magnetic Field on Radiation by Felix Ehrenhaft and R Herzog Compt Rend 227 626-627 (1948) Sept 27 (In French)

Experiments on the influence of an homogenous and longitudinal magnetic field on the radiations from a beta-emitting radioactive sample consisting mainly of Ra-E are described. Under the influence of such a field, it was found that the limiting Al absorber thickness sufficient to prevent blackening of an Ilford photographic plate is considerably increased. (The field strength was 11,000 gauss and the inhomogeneity of the field between the plates and the preparation was less than 0.006.) The plates shown indicate that in the absence of the field, an Al plate 1.8 mm thick was sufficient to absorb the radiation responsible for blackening of the plate, whereas in the presence of the field, even a 3 mm plate was not thick enough to absorb the radiation. Reversing the field polarity did not affect the results, and removing the field resulted in the complete absorption of the radiation investigated. The authors conclude that it is necessary to assume either that the absorbing properties of the aluminum have been modified by the field, or else that the energy of the radiation is augmented by the field. The latter assumption is in accord with magnetophoresis experiments; if corpuscular radiation is disturbed the following relationship exists: $\int \mathrm{div} B \alpha_T \gtrless 0$.

10 Multiple Scattering with Energy Loss by Leonard Eyges Phys Rev 74 1534-1535 (1948) Nov (Letter to the editor)

The distribution function for the lateral and angular displacements of charged particles which undergo multiple elastic scattering in passing through matter is corrected for energy losses due to ionizing collisions which were neglected in Fermi's original formulation (Rossi and Greisen Revs Modern Physics 13 267 (1941)). The applied correction leads to a simple generalization of Fermi's expression.

11 On the Solution of Scattering and Related Problems by B Ferretti and M Krook Proc Phys Soc 60 481-490 (1948) May 1

A method is presented for solving scattering and eigenvalue problems. This is of use mainly in cases where the forces are of short range. The method is based on a Taylor expansion of the radial eigenfunctions about a point where the potential is already rather small. A procedure is given for determining the logarithmic derivative at this point of the solution which is "least singular" at the origin, this is in general the physical admissible solution. 3 references.

12 A Possible Method for Investigation of the Selective Absorption of γ-Rays by Atomic Nuclei by I Barit and others Dok Akad Nauk SSSR 58 1011-1012 (1947) (In Russian)

Research on the selective absorption of γ-rays may give valuable information about the levels of atomic nuclei. The authors recommend that observations be carried out on selective absorption by means of the method of so-called "self indication," analogous to the method used in neutron physics. They present a detailed description of that method.

13 Proton Bombardment of Fluorine by S Devons and H G Hereward Nature 162 331-332 (1948) Aug 28 (Letter to the editors)

The most probable transmutation in the proton bombardment of F^{19} is short range alpha emission according to the formula: $F^{19} + p \rightarrow Ne^{20*} \rightarrow O^{16*} + He^4$; $O^{16*} \rightarrow O^{16} + h\nu$ (6 Mev).

Using the (γ,n) reaction in Cu^{63} as a threshold detector, the capture of gamma rays was observed $F^{19} + p \rightarrow Ne^{20*} \rightarrow Ne^{20} + h\nu$ (Q = 12.8 Mev). A graph is given of counts as a function of proton energy, and a high yield of high energy gamma rays is observed at 660 Kev resonance. The angular distribution of gamma-ray capture is isotropic. Probabilities are that the observed gamma rays are the full energy transitions to the ground state. A radiation width, at resonance, of the order of $\simeq$2 ev is obtained, whereas it was less than 0.1 ev for the others.

ABSORPTION AND SCATTERING OF RADIATION (continued)

14 Short-Range α-Particles from the Disintegration of Sodium, Aluminium and Fluorine by Protons by Joan M Freeman and A S Baxter Nature 162 696-698 (1948) Oct 30

A method of magnetic analysis similar to that used by Burcham and Devons (Proc Roy Soc 173 555 (1939)) has been used to determine the Q-values and detect the short range α-particles in the following reactions:

$$Na^{23} + H^1 \longrightarrow Ne^{20} + He^4 + Q_1$$

$$Al^{27} + H^1 \longrightarrow Mg^{24} + He^4 + Q_2$$

Excitation functions for the two reactions have been plotted for proton energies in the 400-1000 Kev range. These are compared with α-yields and energies obtained for the same reaction on F^{19}. Using the 1938 Cornell range-energy curve for α-particles, the Q-values were found to be 2.14 ± 0.07, 1.32 ± 0.07, 1.73 ± 0.05, and 1.89 ± 0.06 Mev for the reactions $Na^{23}(p,\alpha)Ne^{20}$, $Al^{27}(p,\alpha)Mg^{24}$, $F^{19}(p,\alpha\gamma)O^{16}$, and $F^{19}(p,\alpha\pi)O^{16}$, respectively. The results are in agreement with previous values and with the scheme suggested by Allan and Wilkinson (Proc Roy Soc 194 131 (1948)).

ASTROPHYSICS

15 The Evolution of the Universe by G Gamow Nature 162 680-682 (1948) Oct 30

The masses and diameters of the galaxies present at the beginning of the present uniform expansion of the universe have been evaluated in terms of fundamental constants and basic quantities of nuclear physics. If the universe is in a state of uniform expansion, as has been deduced from the observed "red shift" in the spectra of distant stellar galaxies, we would expect a rapid decrease in the relative abundances of the elements from hydrogen to uranium, however, this does not agree with the observed abundances, assuming that the present distribution represents a "frozen equilibrium state" corresponding to some very high temperature and density in an early stage of universal expansion. The latter has been previously assumed in explaining the relative abundances of the elements. However, the observed distribution shows a rapid decrease for the logarithm of the relative abundance of elements of atomic weight less than 100, while for higher atomic weights the curve levels off to an almost constant value. If, as previously suggested (Phys Rev 70 572 (1946)) on the other hand, the observed abundances represent a dynamical growth process which was arrested in a certain stage by the rapid expansion of the universe, this inconsistency is avoided.

The original state of matter is assumed to be that of a very dense over-heated neutron gas which decayed into protons by β-emission during the initial expansion; from the protons and neutrons, complex nuclei formed, when the temperature of the mixture dropped below a few times 10^{10}°K. (which corresponds to the mutual binding energies of these particles). From this theory, temperatures and the relative concentrations of neutrons and protons are plotted as functions of the age of the universe. By integration of the relativistic expression for the expansion, the author obtains the mass-density of radiation and the density of matter as functions of the time and after determining the various constants the dependence of material density on the age of the universe is determined. From these expressions the masses and diameters of the original galaxies are estimated and found to agree within the limits of accuracy of the method.

16 Meteorites, Relative Abundances, and Planet Structures by Harrison Brown Scientific Monthly 67 383-389 (1948) Dec

The composition of meteorites is discussed with reference to their origin; tabulated data for the average composition of stony meteorites as a function of metal-phase content are given. The value of such a study in the determination of the composition of the inner planets is treated. Relative abundances of the various elements in meteorites are compared in tabular form with their abundances in the sun as recently determined by Unsöld (Z Astrophysik 24, 323 (1948)). By suitably combining meteoritic data with spectroscopic data a table of cosmic relative abundances is obtained; values are given for the following elements: H, He, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, A, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As.

ASTROPHYSICS (continued)

17 On a Case of Radiation Equilibrium in General Relativity Theory and Its Bearing on the Early Stage of Stellar Evolution by O Klein Arkiv Mat Astron Fysik 34 A No. 19 (1948) 11p

It is shown that the Einstein field equations of general relativity theory in the case of unordered radiation allow of spherically symmetrical solutions, corresponding to a mass density, which may be arbitrarily chosen at the centre and approaches at large distances a particular integral, where the density is inversely proportional to the square of the distance from the centre. This result would seem to make it probable that on general relativity theory stars or stellar systems are possible, consisting wholly of radiation in a nearly stationary but in the long run increasingly unstable state, the solution found playing a similar role with respect to such radiation stars as the Emden gas sphere in the theory of material stars. Such a star with a central temperature of $10^{10^{\circ}}$ would correspond to the conditions considered by Beskow and Trefíenberg in their work mentioned above on the origin of the elements the gravitational field, a part from the innermost parts of their star model, arising almost solely from the radiation field.

ATOMIC BOMBS AND WARFARE

18 The Atomic Bombings of Hiroshima and Nagasaki. U S Army Manhattan Engineer District n d 45p

This report describes the effects of the atomic bombs which were dropped on the Japanese cities of Hiroshima and Nagasaki. It summarizes information on damage to structures, injuries to personnel, and morale effect. An eyewitness account of the bombing of Hiroshima by Father J. A. Siemes is included. Maps of the two cities are appended.

19 The Effects of Atomic Bombs on Hiroshima and Nagasaki. United States Strategic Bombing Survey June 30 1946 50p

This report gives a full account of what the atomic bombs did at Hiroshima and Nagasaki together with an explanation of how the bomb achieved these effects, the extent and natures of the damage, the casualties sustained, and the political repercussions from the two attacks. Photographs showing damage done in Hiroshima and Nagasaki are included. Appended are maps of the two cities which show the kinds of damage suffered in various areas.

ATOMIC POWER

20 The Design of an Atomic Reactor by C Rogers McCullough Power Generation 52 No. 12 73 and 136 (1948) Dec

An experimental nuclear reactor was designed in order to illustrate the problems faced and an approach to their solution. The reactor designed was a "thermal" type using graphite as a moderator, U-235 as fuel, and helium as a coolant with an assumed efficiency of 28.6% and a power level of 35,000 KW maximum. Other assumptions made concerned the shape, size, volume of voids, purity of moderator and uranium, reactor temperature, and a number of other factors. The calculated data for reactor size, gas passage area and volume, fuel elements, and heat flux are presented.

21 The Importance of Breeding in Nuclear Power Development by Andrew W Kramer Power Generation 52 No.10 86-89 (1948) Oct

The author stresses the importance of a continuous supply of fissionable materials in the future development of nuclear energy. The physics and the economic aspects of "breeding" as a means of augmenting these materials are discussed.

ATOMIC POWER (continued)

22 Power Plant Analysis by A S Thompson. North American Aviation Report NAA-SR-19 Oct 26 1948 51p

This report demonstrates a general method for the preliminary thermodynamic analysis of a wide variety of power plants. Simple relationships are given for such criteria of power plant performance as thermal efficiency and power output per unit mass of fuel, in terms of aerothermodynamic variables of the cycle. An application of these relationships is made to a generalized four-component power cycle with a one-component, one-phase medium. Curves are presented showing the dependence of maximum power output and cycle efficiency on overall temperature ratio of the cycle and component efficiency.

BIOLOGICAL EFFECTS OF RADIATION

23 A Study of Blood and Salivary Lysozyme in the X-Irradiated Dog by L R Bennett and Vera Collier, Marion Kresage and Paul E Rekers. University of Rochester Atomic Energy Project Report UR-46 Nov 1 1948 12p

Blood and salivary lysozyme activity has been studied in dogs receiving 350 r total body, single dose, roentgen irradiation. The depression of blood lysozyme activity parallels the depression of the white blood cell count post-irradiation and reaches near zero levels by the 12th day in animals that did not survive. The depression in leukocyte values and lysozyme activity is less pronounced in surviving animals. The salivary lysozyme shows no significant change following irradiation.

24 Complications Following Irradiation of the Thyroid Gland by R M Lukens Ann Otol Rhinol and Laryngol 57 633-642 (1948) Sept

Although x-ray irradiation of the thyroid gland for exophthalmic goiter, hyperthyroidism, etc. is considered to be definitely indicated, the five case histories presented in this paper show the damage that can be caused to the blood vessels, overlying tissues, and underlying larynx and trachea when such irradiation is indiscriminate or excessive. The symptoms appearing in these cases were: hoarseness, sensation of lump in the throat, inspiratory dyspnea, wheezing, dysphagia, cough, expectoration, loss of weight, and chest pain. The physical findings were: congestion of the laryngeal mucosa, telangiectasis and scarring of the neck, stenosis of the larynx and trachea, inflammation of the laryngeal mucosa, telangiectasis of the vocal cords, granulomatous lesions in the tracheal walls, and destruction of the ciliary action of the epithelium resulting in viscid adherent tracheal secretions and crusting. The time between termination of irradiation and appearance of the first symptoms was from one to seven years and the patients have been under continuous treatment for relief one year (1 case), three years (1 case), nine years (1 case), ten years (1 case), and eleven years (1 case). Tracheotomy was required in three cases. 3 references.

25 Cytologic Changes in Thymic Glands Exposed in Vivo to X-Rays by Robert Schrek Amer J Path 24 1055-1064 (1948) Sept

Intranuclear, acidophilic vacuoles were observed in many cells of thymic tissue of the rat and rabbit, 3 hours after irradiation with 1000 r of x-rays. On dark-field examination of the suspension of the irradiated thymic tissue, many of the cells had single or multiple primary vacuoles with or without vacuolar walls. Thymic tissue, 5 hours after irradiation, had, on histologic examination, many pyknotic and fragmented nuclei. Suspensions of this tissue had many cells with secondary vacuoles and many fragments of cells. Nonirradiated thymus also had a few cells with intranuclear vacuoles and pyknotic nuclei. The spontaneous and x-ray-induced degeneration of lymphocytes was associated with the formation of intranuclear vacuoles, pyknosis, and fragmentation. Primary intranuclear vacuoles are seen in a higher percentage of cells by dark-field methods than by routine histologic technic. 25 references and 7 plates.

BIOLOGICAL EFFECTS OF RADIATION (continued)

26 Effect of Flavonoids (Vitamin P) on Mortality from Total Body Roentgen Irradiation by William G Clark, Rex P Uncapher and Mary L Jordan Science 108 629-630 (1948) Dec 3

Guinea pigs were fed on Rockland guinea pig ration and given supplementary ascorbic acid in 0.2% concentration fresh daily in the drinking fluid. One group (45) served as controls and the other group (26) as flavonoid treated, for which the drinking water also contained 0.2% "calcium flavonate" prepared fresh daily. After a week of such treatment the animals were given 220-225 r (200 kv, 20 MA, 1/2 mm Cu + 1 mm Al added filtration, 100-cm target distance, 8.5 r/min) total-body irradiation in a single dose. Of the controls 30 (67%) died; of the treated animals 9 (35%) died. The petechial hemorrhages, ecchymoses, and generalized purpura of the treated animals were considerably less marked than those of the controls. It is concluded that under certain experimental conditions a flavonoid preparation derived from lemons and administered in the drinking water, reduces mortality from total-body x-ray irradiation by about half. 11 references.

27 The Effects of Roentgen Rays on the Embryos and Larvae of the Chinook Salmon by Arthur D Welander, Lauren R Donaldson, Richard F Foster, Kelshaw Bonham and Allyn H Seymour Growth 12 203-242 (1948) Sept (See also MDDC-1689)

This article is based on MDDC-1689. An abstract of this document has been listed in Abstracts of Declassified Documents II 121 (1948) Mar 15.

28 Effects of X-Ray on Lymphoid and Hemopoietic Tissues of Albino Mice by G Brecher, K M Endicott, H Gump and H P Brawner Blood 3 1259-1274 (1948) Nov

In order to gather details of the selectivity of radiation injury produced by whole body irradiation of 400 r (186 KV 20 milliamps, at 50 cm with 0.25 mm copper and 0.55 mm aluminum filters, 6.24 minutes), quantitative myelograms, peripheral blood counts, and the histologic appearance of lymphoid tissues were studied in albino mice of the CFW strain during a period of 4 weeks. Measurements were made of the initial damage to all blood forming tissues and the reticulo-endothelial system, the extent and duration of the suppression of their activity, and the rate of their recovery. Nucleated red blood cells disappeared almost completely from the marrow within 24 hours after irradiation. Regeneration of the erythroid series began about the 7th day. Only mild to moderate anemia developed, presumably due to the longevity of red blood cells. Suppression of mitotic activity and diminution of the myeloid marrow were marked during the first week after irradiation. Granulocytopenia in the peripheral blood was severe for a very short period only. In contrast, early damage to the lymphoid tissue was more pronounced and lymphopenia was of longer duration than granulocytopenia in spite of early regeneration of the lymphoid tissues. Differences in the relative amount of damage to lymphoid and myeloid tissues and in their rates of regeneration were not of sufficient magnitude to indicate a truly selective damage to the lymphoid tissues under the conditions of the experiments. No morphologic evidence of damage to the reticulo-endothelial system was found. The possible use of irradiated animals for functional studies of the lymphoid apparatus is discussed.

29 Hydrogen Peroxide and the Indirect Effect of Ionizing Radiations by Tikvah Alper Nature 162 615-616 (1948) Oct 16

Experiments undertaken on bacteriophage S 13 in vitro apparently have shown that when the phage is in dilute solution the hydrogen peroxide formed by ionizing radiations will inactivate it. And in experiments on "indirect effect" of ionizing radiations on this phage the ratio of ionic yield for direct action only to ionic yield in dilute solution is of importance for gaining an insight into the "active radical" mechanism. 6 references.

30 Intestinal Effects of Pelvic Irradiation by Jerome M Maas Modern Med 16 No.21 47-48 (1948) Nov 1

It is estimated that from 50 to 75% of all women treated by gynecologic radiation have permanent rectal sequelae though perhaps unrecognizable. They include extensive scarring, fistual, hemorrhage,

BIOLOGICAL EFFECTS OF RADIATION (continued)

or complete occlusion. Radium implants have been found more harmful than x-rays, and injury was greatest when they were combined for cervical or fundal tumor. The treatment of resulting conditions of proctitis, stenosis, bleeding, and rectovaginal fistula is discussed.

31 The "Mystery" of Biological Radiation Effects by Austin M Brues Bull Atomic Scient 4 341-342 (1948) Nov

The chief purpose of this brief review is to show that there is less mystery about radiation than seems to be realized generally. It is meant to be partially debunking. Some consideration is given to the workings of the process of radiation and detection and tracing of radiation damage.

32 Observations upon the Lymphopenia of X-Ray Irradiation by C H G Price Brit J Radiology 21 481-493 (1948) Oct

Observations made upon 16 women treated for carcinoma with deep x-ray irradiation by a formal technique show that the reaction of the lymphocyte count follows a characteristic pattern. The major change in the total lymphocyte count appears to take place during the early part of a course of treatment, and is mainly shown in the lymphocyte/integral dose curves by the values of component B (an indirect effect, which for small doses may be due to the effect of substances elaborated in the suprarenal cortex and having a regressive effect upon lymphoid tissue). It is suggested that this component may represent the result of the direct action of the radiation (component A), and the drop in the total lymphocyte count due to this is large and relatively rapid. The further drop in the total lymphocyte count which takes place in addition to component A may then be due to the indirect action of the radiation, which effect tends to diminish as the dose of radiation increases. Eventually, a stage is reached at which further irradiation, at the rates of dosage here considered, causes only a very small change in the total lymphocyte count. 16 references.

33 A Preliminary Note on Some Biological Effects of Alpha Radiation on the Frog Tadpole by K Tansley, L H Gray and F G Spear. Brit J Radiology 21 567-570 (1948) Nov

Mitotic and degenerate cell counts were made on the eye and brain of frog tadpoles exposed to three different doses of α-rays and the results compared with those already known for a small dose of γ-rays. Whereas with the lowest α-ray dose the relation between mitosis and degeneration does not differ from that which would be expected to follow a relatively small dose of radiation, after the two larger α-ray doses degeneration far exceeds this amount. It would seem that α-rays cause the degeneration of potential dividing cells in considerable numbers.

34 Radio-Biological Research with Fast Neutrons by A Catsch, K G Zimmer and O Peter Z Naturforsch 2 1-5 (1947) Jan Feb (In German)

Radiation effects of fast neutrons are characterized by damage to the leukocytes whereas the erythrocytes are to a large extent resistant to radiation damage. The effect of radiation on the blood forming organs damages cells in the process of dividing as well as immature cells. As a result of the damage to the blood forming organs, secondary changes in the blood appear long after the irradiation. The importance of these results in determining the tolerance dose lies in the fact that with neutrons changes in the blood picture are apparent even with very small doses. This is quite different from X-rays. Apparently too in the case of neutrons there is no correlation with radiation intensity nor is there a quick recovery as with X-rays. It is important therefore to study the effects of neutrons, especially the correlation between radiation intensity and damage. It is important too to study the effect on other organs in order to properly protect personnel engaged in nuclear research.

35 Relative X-Ray Sensitivity of Metaphase and Interphase Chromosomes by Arnold H Sparrow Nature 162 651-652 (1948) Oct 23

This is a preliminary report of the range of sensitivity of chromosomes to x-ray breakage during microsporogenesis in Trillium erectum. Sensitivity was determined by counting the number of fragments

BIOLOGICAL EFFECTS OF RADIATION (continued)

present at microspore metaphase following irradiation with 50 r at either first meiotic metaphase or early post-meiotic interphase. Data showed first metaphase to be a stage of high sensitivity and early interphase a stage of very low sensitivity. Fragmentation was approximately 50 times greater in the first case. Since these two stages do not necessarily represent the stages of highest and lowest sensitivity, it is considered that a 50-fold increase is a conservative estimate of the actual sensitivity change which occurs during the nuclear cycle. 9 references.

36 The Response of Tissue to Total Body Irradiation by John L Tullis. Naval Medical Research Institute Report 11 July 22 1948 27p

A comparative study of the lesions produced in swine after total body exposure to ionizing radiations from the atomic bomb tests at Bikini and after total body exposure to million volt x-radiations is presented. The lesions produced by the two types of exposure are found to be indistinguishable and to consist mainly of hemorrhage, necrosis and secondary infection. Twelve photographs of gross lesions and 24 photomicrographs illustrate the report.

37 Studies on the Behavior of Fungi in the Presence of Radioactive Isotopes by I A Pearson, J M Hammer, K E Corrigan and H S Hayden J Bact 56 397-402 (1948) Oct

The behavior of 43 pathogenic and nonpathogenic fungi in the presence of radioactive phosphorus, iodine, and high voltage x-ray was studied, and a technique for handling cultures containing radioactive substances was developed. The amounts of P^{32}, I^{131}, and x-ray were not lethal, and exposure to them did not cause any marked changes in the morphology or pathogenicity of numerous fungi studied. It was found that solutions of radioactive phosphorus and iodine have no self-sterilizing properties. Autoradiographs of fungi were made showing that the fungi themselves were radioactive. It was impossible to obtain autoradiographs of single spores or mycelia since considerable scattering was present; the technique is being studied further and developed. 3 plates.

38 A Study of the Hands of Radiologists by Nancy K Braasch and Margaret J. Nickson Radiology 51 719-727 (1948) Nov (See also MDDC-1309)

This article is based on MDDC-1309. An abstract of this document has been listed in Abstracts of Declassified Documents I 718 (1947) Dec 20.

39 The Surgical Repair of Irradiation Defects by David W Robinson J Kansas Med Soc 49 456-461 (1948) Nov

The types of injuries caused by irradiation in different tissues are briefly described and the surgical repair techniques for different structures and different locations are discussed. Cases are classified with respect to etiology as follows: (1) accidental x-ray burns of physicians, (2) injury from intentional massive dosage for neoplasm, (3) late change from repeated small dosage given for superficial therapy, and (4) burns to patients from prolonged exposure under the fluoroscope. The repair of injuries is described in reports of illustrative cases for each etiologic group. 9 references. 5 figures.

40 Threshold and Lethal Doses of Ionizing Radiations by L Mallet and R Maurin J Radio et Electro 29 63-65 (1948) (In French)

In an attempt to set up standards of adequate radiation measurement the authors observed lethality in totally irradiated rats and mice while varying time and the quality of radiation. They considered the minimum effective dose, the LD/50, and the absolute lethal dose. For mice of 20 g and 6 mos., the first was 100 r in one dose at 200 kv, 1 cu + 2 Al, the second, 500 r, and the third, 1000 r. For the purpose of comparing doses the formula $C_1/C_2 = D_2/D_1$ is used. It is derived from the fact that when a daily dose D of radiation type I and a daily dose D_2 of radiation type II bring about the death of 2 comparable subjects in the same time, they are equal. C_1 and C_2 are the respective coefficients. Radiation of 100 kv is particularly efficient, especially for the mouse, and it is observed that the most penetrating radiation is not always the most lethal. For each size of animal there is an optimum wave length, and the bigger the animal is, the shorter the wave length and period of maximum lethality.

BIOLOGICAL EFFECTS OF RADIATION (continued)

41 Thyroid Function in Chickens by C F Winchester. Abstract in J Animal Sci 7 546 (1948) Nov. (Paper presented before 40th Annual Meeting of the American Society of Animal Production, Nov 26-27, in Chicago)

Thyroids of chicks 2 to 5 days old were completely destroyed by intraperitoneal injections of the order of 6 millicuries of iodine^{131} per 100 grams body weight. After an interval of 8 to 28 days, in 4 series of trials, the smaller of each pair of birds injected with iodine^{131} at a given level (4, 6, or 8 mc. per 100 gm body weight) was given daily injections of synthetic thyroxin in water. Thyroxin replacement therapy at levels of the order of 2, 4, and 6 gamma per 100 gm body weight resulted in resumption of body growth and normal feather development. The iodine^{131} treated birds that did not receive replacement therapy remained greatly retarded in these respects.

42 Trauma Resulting from Atomic Explosions by R P Parsons Amer J Surgery 76 559-562 (1948) Nov

For the purpose of generalization, the point of explosion of an atomic bomb may be considered as surrounded by three half-mile wide zones of decreasing injury to men. In the small center circle there will be practically no survivors. They will have perished from direct blast, burns, and radiation. In the next zone there will be many fewer blast injuries, numerous but mostly non-fatal blast burns, and thousands of deaths from radiation as well as thousands of non-fatal radiation victims. In the outer ring (one mile to a mile and one-half) the injuries will be limited mostly to non-fatal flash burns. The nature of the radiation injuries is briefly reviewed.

43 Nature of Trauma in Atomic Warfare by Austin M Brues Amer J Surgery 76 563-566 (1948) Nov

This is a rather general review of events and injuries suffered at Hiroshima and Nagasaki after the atomic bomb attacks.

44 Variation Induced by Uranium Nitrate in Corn Smut and the Cultivated Mushroom by E C Stakman, J M Daly, M L Gattani and I Wahl Science 108 554-555 (1948) Nov 19

By using mildly radioactive uranium nitrate $UO_2(NO_3)_2 . 6H_2O$ in potato-dextrose agar at the rate of 0.5-1.0 gm/liter mutation has been stimulated in the cultivated mushroom, Agaricus campestris, and both mutation and an unusual type of dissociation in the ordinary corn smut fungus, Ustilago zeae. This suggests a simple and useful means for inducing desirable mutations in at least some microorganisms.

BIOLOGY, GENERAL

45 Observations on the Causes of Dyspnea in Chronic Pulmonary Granulomatosis in Beryllium Workers by R A Bruce, F W Lovejoy Jr, George B Brothers and Tulio Velasquez. AECD-2391 (UR-43) Oct 10 1948 Decl Nov 22 1948 51p Proposed for publication in Amer Rev Tuberc

The resting and exercise measurements of pulmonary and cardiovascular functions in six patients with chronic pulmonary granulomatosis are presented in relation to the evolution of the functional impairment and its complications. The results of these studies are essentially in accord with those observed by other investigators of a similar group of patients. The main deviation from normal is the hyperventilation, especially during work, compensating for hypoxemia. Diminished arterial oxygen saturation is a function of abnormally increased alveolar-arterial gradient for oxygen and contracted lung volume, particularly complementary air. One of these patients exhibited polycythemia as a compensatory mechanism. Various stages of cor pulmonale, including congentive heart failure due to increased pulmonary resistance, were observed. An unusual response to intravenous digoxin, and the lack of benefit from cytochrome C therapy are recorded. Variations in response to exercise and similarities to functional impairment of other chronic pulmonary disease are discussed.

BIOLOGY, GENERAL (continued)

46 The Inhalation Toxicity of Sodium Acid Sulfate Mist at 75 mg/m^3 in Animals by George F Sprague, Edward Doran, James K Scott and H E Stokinger. University of Rochester Atomic Energy Project Report UR-48 Nov 12 1948 7p

The purpose of the study was to determine the role, if any, of the sulfate ion in producing the pulmonary changes seen in laboratory animals exposed to beryllium sulfate mist. In order to investigate this problem, 10 rats and 20 guinea pigs were exposed to $NaHSO_4$-H_2SO_4 mist at a mean concentration of 75 mg/m^3 for a total of 82.5 hours over a 17-day period, an interval corresponding to that used in the beryllium sulfate exposure. Body weight loss was observed in but 3 of 30 animals. No pulmonary changes were consistently observed which could be attributed specifically to the sulfate ion. Bronchial epithelial proliferation frequently seen in beryllium sulfate inhalation studies was found in 1 of 18 guinea pigs. It is concluded that sulfate ion, under the conditions of inhalation used comparable to those set in a high-grade beryllium sulfate exposure, is not appreciably toxic to rats, a susceptible species to beryllium sulfate, or to guinea pigs which are less susceptible.

47 Concerning the Inability of 2,3 Dithiopropanol (BAL) to Prevent or to Modify the Acute Renal Injury Induced by Uranium Nitrate by William de B MacNider, Jesse C Trott Jr and Margaret D Bruce J Pharmacol and Expti Therap 94 262-273 (1948) Nov

Uranium nitrate when given subcutaneously to dogs in the amount of 4 mg/kg induced a constant type of acute renal injury which was largely confined to the proximal convoluted segment of the renal nephron. However, no histologically demonstrable cell changes were found in the kidneys of dogs given 15 mg/kg of 2,3 dithiopropanol (BAL). But the use of BAL either as a prophylactic agent before uranium nitrate intoxication was experimentally produced or after, as an alleviating agent, increased the severity of renal injury. Furthermore, renal toxic action of uranium was greatest when BAL was used both before and after. It was concluded from this that BAL so influenced the epithelial tissue of the kidney as a sensitizing agent for uranium that the nephrotoxic action of this substance became more severe at its point of selective action and even spread to other segments of the renal nephron. 17 references.

48 The Pneumonitis and Granulomatosis Peculiar to Beryllium Workers by Frank R Dutra Amer J Path 24 1137-1152 (1948) Nov

This report is compiled from a study of the tissues from 7 persons who died of acute pneumonitis and from 13 persons who died of chronic granulomatosis. The pulmonary lesions in these two clinical conditions are specific and there is evidence of transition of the pathologic lesions of the acute condition to those of the chronic one. In the acute pneumonitis there is a boggy, generalized consolidation of lobes, simulating to some extent the stage of gray hepatization in lobar pneumonia. Microscopically there is diffuse intra-alveolar exudate composed of large mononuclear phagocytes (septal cells) and edema fluid. Intraseptal lymphocytes and plasma cells are also fairly numerous. In one case centrolobular necrosis of the liver has been seen. With chronic pulmonary fibrosis (granulomatosis), the lungs have been voluminous and emphysematous. Scattered diffusely throughout the lungs were many fine nodules. Enlargement of the right ventricle of the heart was constantly present in these cases. Microscopic characteristics include diffuse interstitial and nodular fibrosis of the lungs together with a peculiar granulomatous reaction. The granulomas which are typical of beryllium disease are formed in part within alveolar spaces by the organization of exudate, and in part within the septal and peritruncal connective tissues. They are comprised of central regions of fibrinoid material or granular debris, and the central regions are surrounded by a peripheral zone of fibrosis in which there is an infiltration of lymphocytes and plasma cells. The centers of the granulomas are occasionally occupied by giant cells of the Langhans' type. There are conchoidal bodies in most cases, sometimes within giant cells, sometimes lying free in debris or in fibrous tissue. 17 references and 15 plates.

BIOLOGY, GENERAL (continued)

49 Regulatory Mechanisms of Cellular Respiration. Part I. The Role of Cell Membranes: Uranium Inhibition of Cellular Respiration by E S Guzman Barron, John A Muntz and Betty Gasvoda J Gen Physiol 32 163-178 (1948) Nov 29

This article is based on AECD-2009-H. An abstract of this document has been listed in Abstracts of Declassified Documents II 339 (1948) June 30.

CERAMICS AND REFRACTORIES

50 The Heat Capacity of Beryllium Carbide Powder by J B Trice, J J Neely and Charles E Teeter Jr. Fairchild Engine and Airplane Corporation Report NEPA-816 Nov 10 1948 14p

Rough measurements were made by the so-called "drop" method of the heat capacity of a sample of powdered beryllium carbide. A thin copper capsule containing the material was heated in an electric furnace and dropped into a water calorimeter. The mean heat capacity was found to be 0.5 ± 0.1 calories/gm°C or 0.5 ± 0.1 BTU/lb°F from room temperature to 650°C–950°C (1200°F–1740°F).

51 The Heat Capacity of a Hot Pressed Beryllium Carbide Cylinder by J B Trice, J J Neely and Charles E Teeter Jr. Fairchild Engine and Airplane Corporation Report NEPA-821 Nov 12 1948 12p

The heat capacity of a hot-pressed beryllium carbide hollow cylinder was measured roughly by a radiation method. The range of temperature was from 600°C to 900°C (1110°F to 1650°F). The apparatus for measuring thermal conductivity by the method of radial heat transfer was used for this project. The results can be expressed by the single value:

$$c_p = 0.5 \pm 0.1 \text{ cal/gm°C} = 0.5 \pm 0.1 \text{ BTU/lb°F}$$

52 Basic Refractory Structure by Everett C Hite, Canton, Ohio, assignor to The Timken Roller Bearing Company, Canton, Ohio. U S Patent No. 2,454,922 Nov 30 1948

This patent provides a method of bonding basic refractory brick structures, allowing at the same time for expansion of shapes. A layer of asbestos between the bricks provides the autogenous bond when heated to 2600°F, without causing fusing.

53 High-Temperature Ceramic Coatings for Molybdenum Chem and Eng News 26 3362-3363 (1948) Nov 8

Investigations were carried out by the National Bureau of Standards which show that molybdenum with specially designed ceramic coating offers a promising combination for high-temperature service. The ceramic coatings are applied in the form of water suspensions ("slips") by dipping or spraying, and are then dried and fired at 2150°F in oxygen-free atmospheres. A particularly good coating consisted of the following: (1) Base coat of low-expansion frit, with 20% zirconia added, (2) cover coat containing 95% zirconia, (3) seal coat consisting of a thin application of same composition as the base coat. Results show a great retardation of the oxidation of molybdenum. At 3500°F gas temperature (2600°F surface temperature), only short-time protection is afforded. However, this protection is sufficient for several applications.

54 High Temperature Ceramic Materials by A L Berger Tech Data Dig 13 No.23 13-18 (1948) Dec 1

The problem of high-temperature materials for application to all forms of prime movers to improve thermal efficiency and to save strategic materials has resulted in efforts to develop ceramic coatings, ceramic bodies, and/or composite materials of ceramic and metal combinations as a means of improving the high-temperature characteristics of known materials. The results of these studies by various research organizations are briefly described. A chart is given which shows materials with

CERAMICS AND REFRACTORIES (continued)

exceptional high-temperature characteristics which are being investigated. A second chart is included which presents the physical and chemical properties of the following ceramic refractories: alumina, beryllia, magnesia, silicon carbide, thoria, zirconia, zircon, spinel, graphite and carbon.

CHEMISTRY, ANALYTICAL

55 Use of Ion Exchangers in Analytical Chemistry by R H Lafferty Jr. Carbide and Carbon Chemicals Corporation K-25 Plant Report K-302 Nov 19 1948 19p

Although there has been a wide increase in the industrial applications of ion exchangers since synthetic exchangers were discovered by Adams and Holmes in 1935, the uses of these materials in analytical chemistry to date have been rather limited. This paper discusses the analytical applications of ion exchange techniques which have appeared outside of Atomic Energy Commission publications.

The utilization of ion exchangers falls into the following general classes both for analytical chemistry as well as industrial work. (1) Removal of impurities: In analytical chemistry this frequently involves a complete separation of anions and cations followed by a determination of the anions as acids. (2) Concentration of trace amounts of materials: Although this application is the most obvious field of interest to the analytical chemist, it has received the least attention to date. (3) Separation of materials: This use has been widely exploited in the field of biochemistry, particularly in the analysis of amino acids. (4) Miscellaneous applications: Ion exchangers are used frequently in studies of complex ions to determine the nature of the ions existing in the complex.

56 Chemistry of Thorium by Therald Moeller and Nancy Downs Fritz Analyt Chem 20 1055-1058 (1948) Nov

By modifying the method of Cherniknov and Uspenskaya (Zavodskava Lab 9 276 (1940)) the authors have developed a procedure for accurate and rapid determination of thorium in the presence of yttrium and the rare earth elements. The method involves precipitation as iodate from solutions containing nitric acid, with consequent iodometric determination of the iodate in the precipitate. The procedure was tried out on several synthetic mixtures as well as on monazite sands. It is seen that 99% of the thorium in a pure salt solution may be estimated rapidly and with excellent precision.

57 Chromatography by Roger Williams Jr and J V Hightower Chem Eng 55 No.11 133-138 (1948) Nov

The new unit operation, chromatography, is first explained in a fundamental way. Column design is discussed, and it is stated that packing correlations by Colburn and Chilton (in Perry's "Chemical Engineers' Handbook," McGraw-Hill Book Co., New York, 1941, p. 829-830) and Meyer and Work (Trans Amer Inst Chem Engrs 1937 13-33) can be used for predicting pressure drops in these columns in spite of the small sized particles. Columns and methods used by Valley Vitamins, Inc., and Merck and Company are described.

58 A Colorimetric Determination of Thorium by B F Rider and M G Mellon Anal Chim Acta 2 370-376 (1948) Sept

A colorimetric method for determining thorium, based on the precipitation of thorium oxalate and subsequent reaction of the excess oxalate ion with permanganate, has been developed. Several variables affecting this method were critically studied, and it is concluded that determinations may be made in the range of 3-30 mg of thorium in 1 cm cells.

59 Detection of Lead in Air with the Aid of a Geiger-Muller Counter by O G Koppius. Abstract in Analyt Chem 20 p112 (1948) Nov. (Paper presented at the 33rd Meeting of the Optical Society of America, Oct 21-23, in Detroit)

A detector of lead in air was described, It utilizes a spark source for the excitation of the lead spectrum, a small quartz spectrometer for the dispersion, and a quartz Geiger-Muller counter for the detector of the radiation. The lower limit of detection is of the order of 20 micrograms of lead per cubic foot of air. The instrument is mobile and ideally suited to locate areas of high lead concentration in air.

CHEMISTRY, ANALYTICAL (continued)

60 Diaminobenzidine as a Reagent for Vanadium and Selenium by J Hoste Analyt Chim Acta 2 402-408 (1948) Sept

First of all diaminobenzidine is described as a reagent for V^{+5}. It behaves in this respect, similarly to benzidine. On the other hand, with selenium there is formation of a piazselenole, which is insoluble in both acid and alkaline media and is intensely yellow colored. Hence it is possible to detect Se^{+4} in this way in dilutions down to $1:10^6$. At the same time the reaction is quite specific, but is interfered with by the presence of oxidizing constitutents.

61 Fluorine Separation and Determination by E Rinck Bull Soc Chim France No.3-4 305-324 (1948) Mar-Apr (In French)

The author has examined the principal methods of fluorine analysis. Among the gravimetric methods, those by Berzelius (Ann Chim Phy 3 34 (1816)) and Rose (Ann Chem Justus Liebigs 72 343 (1849)) seem to be the best when precipitating in an acetic medium at proper pH. If it is possible to avoid isolating FClPb, analysis of lead fluorides gives good results. No satisfactory method seems to have been devised for the determination of the fluorides or fluosilicates of La, Y, Bi, Th, K, and Bo. Of the various volumetric methods of analysis, one using thorium nitrate seems the most satisfactory. Some colorimetric methods, such as those based on the fluorine decolorizing action on peroxititanic acid, or the color change of ferric ferron, also give good results. All analytical methods are sensitive to foreign ions, presenting a separation problem in all cases. Distillation in the form of SiF_6H_2 was carefully examined and seems to be the best method. Curves and data are presented and 86 references given.

62 Identification of Fluorides in Conditions of Specificity by Hector Luis Fasano Rev Facultad Cienc Quim 21 69-80 (1946) (In Spanish)

A new, sensitive and specific technique for the identification of fluorine is presented. It consists of distillation of fluorine as BF_3, extraction of the H_2F_2 in the distillate with ether, and the reaction of alizarin red S-zirconium with H_2F_2. The method has been tested in solutions and in the absence of organic material and it is possible to identify as little as 5 gammas ($= 5 \times 10^{-6}$ gm) of fluorine. It was tried in the presence of the common and less rare cations and anions, and by adopting certain precautions it was possible to eliminate the disturbing action which some of these ions can cause. In the presence of 10,000 gammas (= .01 gm) of extraneous ions it was possible to identify as little as 10 gammas ($= 10^{-5}$ gm) of fluoride. 19 references.

63 An Improved Apparatus for Rapid Electrodeposition by F T Rabbitts Can Chem and Process Ind 32 1023-1025 (1948) Nov

The author has developed an improved method for rapid quantitative electrode position of metals. The stirring action, of variable intensity, simple, positive, and independent of current density, is effected by a stirrer made of soft iron sealed in glass and a rotating permanent magnet beneath the electrolysis vessel. The polarity of the electrodes may be changed, and the current density easily controlled. The improved design eliminates any spray losses and corrosion errors.

64 The Mechanism of Chromatogram Formation by E N Gapon and T B Gapon Doklady Akad Nauk 60 817-820 (1948) May 11 (In Russian)

Reference is made to the tentative classification of the chromatographic phenomena suggested by the authors in a previous work (Doklady Akad Nauk 59 921-924): (1) selective molecular adsorption, (2) ion exchange between the solution and the adsorbent, (3) precipitation. A particular case of the first type, chromatographic analysis of vapors, was first studied by Dubinin. An example is the sorption of vapors of ethyl alcohol and toluol along an activated coal column. (M M Dubinin and M Khrenova, Zhur Priklad Khim 9 1204 (1936)). The second class (ion exchange) is illustrated by the authors' work on the chromatographic separations of certain metal ions. The pair Cu^{++}-Co^{++} were found to separate readily upon the following adsorbents (Cu^{++} in the upper zone): permutite, bentonite clays, barium aluminate,

CHEMISTRY, ANALYTICAL (continued)

zinc oxide (specially treated), aluminum oxide (specially treated). The following produced little or no separation: kaolinitic clays, glauconite, Hammersten's casein, soils. A typical example of a poorly separating pair is Co^{++} - Ni^{++}, but they were separated by a permutite prepared by the authors.

In the previous work cited above, the authors studied the dependence of the chromatographic effect on the adsorption constants of the components. In the present article they discuss the part played by the lattice structure of the adsorbent. Kaolinite, with crystal hollows 2-3 A wide, is capable of extracrystallic adsorption only. On montmorillonite (chief component of bentonitic clays), which has hollows 8-20 A wide, intracrystellic adsorption can take place. The hollows in chabazite are 3-5 A wide. Accordingly, the exchange of NH_4^+ (2.9 A diameter) on Ca-chabazite is intracrystallic, while that of $N(CH_3)_4^+$ (7 A diameter) is extracrystallic; this difference permits the chromatographic separation of NH_4^+ (adsorbed) from $N(CH_3)_4^+$ (in the filtrate). On natrolite the exchange of monovalent ions is intracrystallic, that of bivalent ions extracrystallic; therefore, natrolite could be used for the separation of the two kinds of ions.

65 A New Method for Determination of Fluorine by Means of the Alteration of Glass-Surface by G Canneri and D Cozzi Analyt Chim Acta 2 321-327 (1948) Sept

A new method for detecting fluorine was developed by modifying the apparatus and procedure used by Dubnikov and Tikhomirov (Zavodskaya Lab 11 1028-1032 (1945)). A standard microscope cover glass is used, and the wetting of this glass by chromic acid containing HF is an indication of fluorine content. Since the authors noted that the contact angle of the chromic acid drop depends on the amount of fluoride ion, a still more sensitive method was developed. This method uses essentially only a horizontal microscope and a capillary tube and depends on the fact that at standard conditions the contact angle of a tiny air bubble at the bottom of the capillary tube remains the same for a fixed F^- concentration. The apparatus is described and experimental curves are given.

66 Notes on Masking of Molybdenum-, Tungsten-, and Vanadium-Reactions by Fluoride by F Feigl Analyt Chim Acta 2 397-401 (1948) Sept

It is noted that the precipitation and color reactions of $MoO_4^=$, $WO_4^=$, and the greater part of VO_3^- are masked in acid and fluoride-ion-containing solutions. Addition of boric acid enables demasking. Experiments are described.

67 On the Dynamics of the Ion Exchanges by D D Ivanenko, V V Rachinskii, T B Gapon and E N Gapon Doklady Akad Nauk SSSR 60 1189-1192 (1948) June 1 (In Russian)

The phosphate-ion exchanges (biologically important soil reactions) belong to the ion-exchange type of chromatographic adsorption. Using the method of labelled phosphorus (Klechkovskii, Ivaneko, Bagaev and Rachinskii, Doklady Akad Nauk SSSR 58 93 (1947)), the authors studied these phenomena with a column of aluminum oxide, treated with HNO_3, as an adsorber. After the reaction with a solution of a known quantity of sodium phosphate, the column was washed with water; a triple elution with 1 N NaOH followed, which showed two characteristic maxima on the distribution curves corresponding to ions $H_2PO_4^-$ and HPO_4^{2-} (PO_4^{3-} being practically nonexistent at the pH = 6.2 used). In the first stage of the process the adsorbed NO_3^- exchanged places with $H_2PO_4^-$; in the second stage (elution), the latter was replaced by the hydroxyl of NaOH; the HPO_4^{2-} ions were adsorbed in the lower part of the column. For the theoretical treatment of the phenomenon, both in static and dynamic conditions, the authors refer to a previous work (T Gapon, E Gapon and Shemyakin, Doklady Akad Nauk SSSR 58 595 (1947)).

68 Photofluorometric Determination of Gallium in Tissues by Horace C Dudley. Naval Medical Research Institute Report 1 Jan 5 1948 12p (NP-456)

It was necessary to develop an analytical procedure which could measure micro- and semi-micro quantities of gallium. The method described is based on the fluorescence produced by ultraviolet light of gallium 8-hydroxyquinoline in chloroform. The selectivity and specificity are obtained by closely controlling the pH between 2.5 and 2.8. The procedure permits the extraction and estimation of the element of the order of 2 to 100 micrograms (gamma) in 10 grams or less of tissue or other biological materials.

CHEMISTRY, ANALYTICAL (continued)

69 Separation of Radium from Barium by the Use of an Ion-exchange Column Procedure by Edward R Tompkins J Amer Chem Soc 70 3520-3522 (1948) Oct (See also AECD-1998)

This article is based upon AECD-1998. An abstract of the document appeared in Abstracts of Declassified Documents II 331 (1948) June 30.

70 The Spectrographic Determination of Fluorine in Organic Substances by Charles W Rankin. Abstract in Analyt Chem 20 1128 (1948) Nov (Paper presented at the 33rd Meeting of the Optical Society of America, Oct 21-23, in Detroit)

Two methods of determining fluorine in trace quantities were attempted: the detection of the 5291 A band of CaF_2, and the detection of fluorine in the high current density spark. Using either method, as few as 100 micrograms of sodium fluoroacetate were detected.

71 Theory of the Chromatographic Analysis of M S Tsvet by E N Gapon and T B Gapon Doklady Akad Nauk SSSR 59 921-924 (1948) Feb 11 (In Russian)

As the formation of chromatograms by organic and inorganic substances is due to entirely different mechanisms, a general theory of chromatographic adsorption should not be attempted. Nevertheless, it is possible to distinguish between three main types of mechanisms: (1) molecular adsorption, (2) ion exchange between the adsorbent and the solution, and (3) precipitation. The authors present some fundamental considerations for a theory of the first two types. (1) In discussing the chromatographic analysis based on molecular adsorption, the ideas of Dubinin, who has studied the dynamics of vapor sorption, are followed. (M M Dubinin and S Yavich, Zhur Priklad Khim 9 1191 (1936); M M Dubinin and M Khrenova, Zhur Priklad Khim 9 1204 (1936)). The equations used are those of Langmuir describing the equilibrium between the components in the solution and on the adsorbent. The adsorption constants, characteristic of every component, determine the shape and position of the maximum of the individual adsorption curves taken along the adsorbent column. Subsequent development expands and separates the individual curves. (2) In the equilibrium equations describing the phenomenon of ion exchange, the volume of the pores per unit volume of the adsorbent is taken into account. An exact computation of the composition along the column would require the integration of a differential equation. The authors preferred the more expedient method of finite differences.

CHEMISTRY, GENERAL

72 The Preparation of Ruthenium Pentafluoride and the Determination of Its Melting Point and Vapor Pressure by H A Bernhardt, R L Farrar Jr, R A Gustison and S S Kirslis. AECD-2390 (K-294) Nov 1 1948 Decl Dec 3 1948 17p

Pure samples of ruthenium pentafluoride were prepared by direct fluorination of ruthenium metal at 300°C. The melting point, determined by the method of cooling curves, was found to be 106°C. Using a diaphram type vapor pressure apparatus, the vapor pressure was measured and found to be expressed by the following equations:

$$\text{(Liquidus)} \qquad \log P_{mm} = 7.607 - \frac{2770}{T}$$

$$\text{(Solidus)} \qquad \log P_{mm} = 13.62 - \frac{5052}{T}$$

The liquidus equation indicates a boiling point of 313°C. The heat of vaporization, sublimation and fusion, and the entropy of vaporization and fusion were calculated.

73 The Synthesis of D-Glucose-1-C^{14} by H R Mahler. AECD-2400 (UCRL-174) Sept 8 1948 Decl Dec 3 1948 88p Proposed for publication in J Amer Chem Soc

Glucose, labelled unambiguously in one of the positions of its carbon skeleton, would be a tool of inestimable value in the investigation of chemical, biological and biochemical processes. The purpose of this research has been to investigate the synthetic tools available; to evaluate them according

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to ease of adaptation for work with radioactive isotopes, to find conditions for maximum yields, and to make a critical evaluation and choice where two or more methods appeared available. Several attempts to deaminate 1,2-acetone-6-desoxy-6-amino-D-glucose and its desacetonated product were made in order to devise a method for obtaining D-glucose through a condensation of 1,2-acetone-D-xylotrihydroxyglutaric dialdehyde with nitromethane. These investigations had the aim of arriving at a useful synthesis of D-glucose-6-C^{14}.

Several methods of synthesizing nitromethane were evaluated in order to arrive at a method suitable for obtaining nitromethane-C^{14}. Another reaction studied was the Nef reaction between the sodium salts of aliphatic nitro-compounds and mineral acids. Nitropropane was chosen as the model compound, and an analytical procedure for the assay of propionaldehyde in the reaction mixtures worked out. Using carbon-14, a modification of the synthesis of methyl iodide-C^{14} had to be found which did not employ phosphorus. This was achieved by the treatment of aqueous methanol with hydrogen iodide of specific gravity 1.96. Nitromethane-C^{14} was synthesized, condensed with arobinose, taken through the steps of the Sowden-Fischer synthesis, and D-glucose-C^{14} and D-mannose-C^{14} isolated, although not in crystalline form so far. It has been possible, however, to prepare these two sugars in crystalline form with low specific activities, by the device of co-crystallization with inactive material as carrier. 38 references.

74 The Preparation of Carbon-14 from Barium Carbonate-C^{14} by I W Ruderman and C S Wu. AECD-2412 (CUD-14; DR-1089) Nov 15 1948 Decl Dec 14 1948 11p Proposed for publication in J Amer Chem Soc

The reaction of lithium, sodium, potassium, and magnesium with barium carbonate at elevated temperatures under various conditions was studied. Carbon-14 was prepared in 60% yield from barium carbonate-C^{14} by the reduction of the carbonate with lithium at 650° in a sealed nickel tube.

75 Biosynthesis of Radioactive Drugs Using Carbon 14 by E M K Geiling, F E Kelsey, B J McIntosh and A Ganz Science 108 558-559 (1948) Nov 19

A method of preparing radioactive digitoxin and nicotine by biological synthesis in the medicinal plants, Digitalis purapurea and Nicotiana rustica, and their recovery from the plants are described in this report.

76 Boron Hydrides. Final Report on Contract 173s-10421 by H I Schlesinger et al. Naval Research Laboratory Report NRL-P-2964 (University of Chicago) July 1946 79p

This final report is essentially a guide to the contents of the various monthly reports, copies of which are incorporated therein. The subject matter is arranged in accordance with the compounds studied. These include aluminum borohydride, aluminum hydride, lithium aluminum hydride, pentaborane, hydrides of silcon and tin, alkyl silanes and stannanes, zinc alkyls, beryllium hydride and methyl beryllium hydride, zinc hydride, zinc borohydride, alkyl aluminum borohydrides, etc.

77 Progress Report No. XXVI on Hydrides and Borohydrides of Light Elements by H I Schlesinger and A E Finholt. Naval Research Laboratory Report NRL-C-3107 (University of Chicago) Apr 1947 25p

The report covers experimental work on the following: preparation and properties of hydrides of aluminum and magnesium, preparation of sodium aluminum hydride, physical properties of dimethyl aluminum hydride, and reactions between B_5H_9 and B_2H_6 with and without added hydrogen.

78 Do the Noble Gases Form Addition Compounds with Boron Fluoride? by Egon Wiberg and Kurt Karbe Z Anorg Chem 256 307-317 (1948) July (In German)

Krypton-borontrifluorides and xenon-borontrifluorides were cryoscopically examined and experiments were performed for the separation of xenon-borontrifluoride compounds. The authors found that krypton as well as xenon is not miscible with boronfluoride in the liquid state. In the case of krypton (m.p. - 157°) and boronfluoride (m.p. - 128°), freezing started in the upper boronfluoride

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layer and started shortly below the BF_3 melting point. In the case of xenon (-112°)-BF_3 mixtures, the freezing started just below the xenon melting point. Booth and Wilson (J Amer Chem Soc 57 2273 (1935)) showed that in the case of argon and BF_3 in the liquid state at pressures of over 40 atmospheres, two immiscible layers are formed. However, the melting points for the six compounds they claimed to have discovered are very close to that of BF_3, and it seems that the difference in melting points was due to secondary effects, such as supersaturation, freezing point lowering, supercooling, etc., particularly since the entire diagram extends over only 5°. In the reported experiments, no compounds could be proven, and the entire xenon could be distilled off from mixtures of Xe and BF_3 at -183°. The experimental apparatus is discussed in detail.

79 Encyclopedia of Chemical Reactions (5 Volumes) Volume 2: Cadium, Calcium, Carbon, Cerium, Cesium, Chlorine, Chromium. Carl A Jacobson, Compiler and Editor. New York, Reinhold, 1948 917p

This reference work includes some 3331 reactions for the elements indicated in the title. The contents are alphabetically arranged, first as to formulas and next as to reagents, and contain explanatory paragraphs describing the conditions of the reactions.

80 Gallium Chemistry. Bimonthly Report for Period Feb 1 1948 - Apr 1 1948. University of Illinois (Office of Naval Research Contract - Bimonthly Report 5) nd 15p (NP-459)

Quantitative observations on the hydrolysis of gallium (III) chloride solutions were made by means of pH measurements at various concentrations. For solutions varying in concentration from 0.001 to 0.3334M, the calculated hydrolysis constants varied from 7.2×10^{-4} to 2.4×10^{-4}, the average being 4.03×10^{-4}. Electrometric titrations of gallium (III) chloride solutions with standard sodium hydroxide solution have also been carried out. For solutions varying in concentration from 0.15M to 0.01M, the pH necessary for the appearance of hydrous gallium oxide hydrate varied from 4.51 to 5.50, while the mole ratio of OH^- to Ga^{+++} at precipitation incidence varied from 2.97 to 3.21. It has been shown that gallium can be extracted quantitatively from dilute aqueous gallium (III) sulfate solutions by shaking solutions buffered with sodium acetate to pH values between 3.0 and 4.2 with chloroform solutions of 8-hydroxyquinoline (oxine). In this range, the same cations which interfere with the corresponding extraction of indium will interfere.

81 Gallium Chemistry. Bimonthly Report for Period Apr 1 - June 1 1948. University of Illinois (Office of Naval Research Contract - Bimonthly Report 6) nd 18p (NP-460)

Quantitative observations concerning the hydrolysis of gallium salts were extended to solutions of gallium (III) nitrate. For gallium (III) nitrate solutions varying in concentration from 0.001 to 0.262 M, the hydrolysis constant, calculated from pH measurements, varied from 6.3 to 2.5×10^{-4}. Electrometric titrations of gallium (III) nitrate solutions with standard sodium hydroxide solution were also carried out. For solutions varying in concentration from 0.123 to 0.010 M, the pH necessary for the appearance of hydrous gallium oxide hydrate varied from 4.78 to 5.38, while the OH^- to Ga^{+++} ratio at precipitation incidence varied from 2.78 to 3.02.

Gallium was shown to be quantitatively extracted from dilute aqueous gallium (III) sulfate solution into chloroform as the 8-hydroxyquinoline derivative at pH values between 3.0 and 6.2. Control of pH was effected by addition of sodium acetate alone or in combination with sodium hydroxide.

Thallium (III) ion was found to precipitate quantitatively from sulfuric acid solution as the 8-hydroxyquinolate. The thallium derivative is bright yellow in color and has the formula $Tl(C_9H_6NO)_3$. The complex turns dark brown when heated to 167° and melts with decomposition at 167-169°.

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82 Gallium Chemistry. Biomonthly Report for Period Aug 1 - Oct 1 1948. University of Illinois (Office of Naval Research Contract - Bimonthly Report 8) nd 12p (NP-641)

Preliminary experiments are described, the data from which may be used in evaluation of the basicity of gallium. The residue from the photochemical decomposition of thallium (III) oxinate has been analyzed. Its composition closely approaches that given by the formula $Tl(C_9H_6NO)$, i.e. that of the thallium (I) compound. A pure sample of the latter has been prepared.

83 Chemistry of Gallium. Progress Report Feb 1 1948 - Apr 1 1948 by Henry Taube. University of Chicago Department of Chemistry (Office of Naval Research Contract) nd 8p (NP-462)

A large electrically heated bath has been constructed for use in the measurements of the vapor pressure and vapor density of ammonium chlorogallate; using a molten salt mixture as the liquid, the apparatus will serve for temperatures up 450°C. A small sample of gallium dichloride was purified by recrystallization from benzene. Part was analyzed and found to be 99% pure. Efforts were made to develop methods described earlier to the point where a reasonable yield of pure product of ammonium chlorogallate could be obtained. A sample which is at least 99.9% pure is required for the determinations of vapor pressure, vapor density, and for other experiments. Attempts to prepare samples of such purity have been unsuccessful. Potassium chlorogallate was prepared using a method reported previously by heating potassium chloride with an excess of crude ammonium chlorogallate. The mixture was heated strongly until all volatile material was dispelled, leaving a clear melt of $KGaCl_4$. Reaction of $KGaCl_4$ with dry HCl is discussed.

84 Liquid Fluorine-Cotton Explosion by R H Lafferty Jr, J C Barton and J A Westbrook Chem and Eng News 26 3336-3337 (1948) Nov 8 (See also AECD-1848).

This article is based on AECD-1848. An abstract of this document has been listed in Abstracts of Declassified Documents II 264 (1948) May 15.

CONTROL OF ATOMIC ENERGY

85 The International Control of Atomic Energy; Policy at the Crossroads. An Informal Summary Record of the Policy Developments Concerning the International Control of Atomic Energy, Oct 15 1946 to May 17 1948. Department of State Publication 3161, General Foreign Policy Series 3 251p

The record of U. S. participation in the United Nations Atomic Energy Commission since October 1946 is presented. The commission report on May 17, 1948 recognizes "that the factors necessary to bring about agreement on an effective international control are outside its competence and that other means and avenues of establishing cooperation must now be explored."

86 Social Implications of Modern Science Annals of the American Academy of Political and Social Science 249 1-176 (1947) Jan

Scientific knowledge has outstripped social understanding, and recently technological progress has outstripped both scientific discovery and social adjustment and has harnessed science for anti-social purposes. Now, in the immediate postwar years problems are arising from extremely limited experiences in productive social uses of modern science. These problems are considered in this series of lectures (presented during the Summer Session of the University of Michigan) on understanding the social implications of modern science. In the section titled "Technology and Society" are: Recent Advance in the Physical Sciences, by H. R. Crane; The Atomic Crusade and Its Social Implications, by Arthur H. Compton; Some Social Implications of Natural Resources, by Howard A. Meyerhoff. In the section titled "Political Implications" are: The Atomic Dilemma, by Bernard Brodie; World Government and the Control of Atomic Energy, by Herbert W. Briggs; Civil Liberties in the Atomic Age, by Robert E. Cushman; Total War and the Preservation of Democracy, by Arthur W. Bromage. In the section titled "Science and Social Change" are: Psychology of Social Change, by

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Donald G. Marquis; How Technology Changes Society, by William Fielding Ogburn; Law and Atomic Energy, by E. Blythe Stason; Some Economic Consequences of Science, by Sumner H. Slichter. In the section title "Conjunction of Social and Physical Sciences" are: The Impact of Science on Population Growth, by Warren S. Thompson; Nutrition, by Howard B. Lewis; The Political Impact of Modern Science on Public Health, by Gaylord W. Anderson; Secondary Education for a New World, by John W. Studebaker; Responsibility of Social Science, by Louis Wirth. In the section titled "The Problem of Values" are: Security, Freedom, and Modern Technology, by William Haber; The Humanities in a Scientific World, by Hayward Keniston; Good, Evil, and Beyond, by George N. Shuster.

CORROSION AND ANTI-CORROSION

87 The Corrosion Handbook edited by Herbert H Uhlig and sponsored by The Electrochemical Society Inc New York. New York, John Wiley and Sons Inc 1948 1188 p

This handbook is, as the name implies, a condensed summary of corrosion information, including a cross section of scientific data and industrial experience. The contents include a discussion and outline of the corrosion mechanism, corrosion data of the various industrial metals and alloys in liquid media and gaseous atmospheres, corrosion data of various metals (including aluminum) at high temperatures, and a discussion of high-temperature resistant materials. The corrosion of carbon and graphite, and other refractories is also discussed.

88 Corrosion Inhibitors by A G Sussex Metal Treatment and Drop Forging 15 159-164 (1948) Autumn

The author discusses the mechanism of inhibition as well as the use of many inhibitors, with particular emphasis being placed on chromates and soluble oils. 28 references.

COSMIC RADIATION AND MESONS

89 Magnetic Deflector for Mesons Produced in the 184-Inch Cyclotron by W K H Panofsky and E A Martinelli. AECD-2402 (UCRL-192) Oct 11 1948 Decl Dec 6 1948 12p Proposed for publication in Rev of Sci Instruments Document for sale by AEC

The artificial production of mesons by means of high energy α-particles in the 184-inch cyclotron at Berkeley (Gardner and Lattes, Science 107 270 (1948)) indicated the desirability of making mesons available outside the cyclotron tank in order to make investigations possible by means other than photographic plates inside the tank. A magnetic deflector to draw mesons out into a re-entrant chamber in the cyclotron wall was therefore constructed. The circulating α-particle beam strikes a target at a radius of 80 1/2" from the center of the cyclotron. The magnetic field at the target position is close to 14,000 gauss, so that low energy mesons are unable to leave the cyclotron. The magnetic deflector consists simply of a magnetic shield placed in such a manner that it shields the meson beam and permits it to enter a re-entrant chamber in the cyclotron wall.

90 The Capture Probability of Negative Mesotrons by Harold K Ticho Phys Rev 74 1337-1347 (1948) Nov 15

Disintegration curves of positive and negative mesotrons stopping in H_2O, NaF, Mg, Al, and S have been determined. The relative counting rates of positive and negative disintegration electrons support the view that the change of the mean life of negative mesotrons can be interpreted as due to a competition between the processes of spontaneous disintegration and nuclear capture. The mean-life values of positive mesotrons in the various materials are in agreement and when averaged give a value of 2.11 ± 0.10 μsec. From the mean life values of negative mesotrons the capture probabilities of mesotrons in the neighborhood of the absorber nuclei are calculated and shown to obey an empirical law of the form kZ^a with $a = 3.7 \pm 0.85$.

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91 Cosmic-Ray Bursts at Sea Level and under Thirty Meters of Clay by Chou Chang-Ning Phys Rev 74 1659-1666 (1948) Dec 1

Cosmic-ray bursts have been investigated by means of ionization chambers made of Duralumin, which were filled with argon to pressures of about 82 atm at 0°C. The bursts were registered with recording electrometers. The experiments were carried out at sea level and in an underground station under 30 meters of clay. At both levels runs were made with the chambers unshielded and also with sheets of aluminum (up to 33 cm) and of lead (up to 18 cm) placed above them. In all, about 3000 hours at the underground station and 1000 hours at sea level were successfully recorded. The author claims the results obtained underground are the first systematic investigation concerning bursts observed far below sea level. The air-lead transition curves taken under the clay show a flat maximum which occurs at a greater thickness of lead than that observed at sea level.

92 Cosmic Rays by G D Rochester British Science News 1 No.10 11-14 (1948)

The author presents a brief, non-technical summary of present knowledge of cosmic rays. The hard and soft components of the radiation and some observations on the meson are discussed; cloud chamber photographs of tracks produced by particles present in cosmic rays are shown.

93 Cosmic Rays by L Janossy. London, Oxford University Press 1948 424p

Theoretical and experimental work contributing to present knowledge of the nature and origin of cosmic radiation and the meson are treated extensively. The following are briefly summarized in an historical introduction preliminary to the detailed discussion: the discovery of cosmic radiation, the penetrating power of cosmic rays, cosmic-ray particles. Applications of the various types of detectors to such studies are discussed; the ionization chamber, Geiger-Muller counter, cloud chamber, proportional counter, and photographic plate method are included. The classical theory of fast collisions is developed and treated from the standpoint of quantum mechanics as an introduction to the theories of meson and beta decay subsequently discussed. Theoretical expressions for elastic, inelastic, and radiative collisions are summarized. The nature of the ionizing and non-ionizing components of cosmic rays at sea level and underground are discussed. Mathematical and experimental investigations of the following are presented in some detail: 1) the instability of the meson, 2) the soft component of the radiation, 3) geomagnetic effects, and 4) extensive air showers. The author concludes with a discussion of the probable origin of cosmic radiation and the various theories of meson production. The following are given in appendices: 1) the statistical treatment of observation in terms of distribution functions and the analysis and correlation of data, 2) auxiliary tables for cascade computation, and 3) the photographic method. An extensive bibliography (9p) is given.

94 Evidence for the Existence of a Low-Mass Mesotron by E W Cowan Science 108 534-535 (1948) Nov 12

A cloud chamber photograph is shown as evidence for the existence of a particle having a mass 11.4 times that of the electron. The photograph was taken at 8,850 m with a random expansion of a cylindrical cloud chamber of 87 cm diameter and 15 cm depth containing about one atmosphere of argon and saturated with ethyl-alcohol vapor. The assumptions made in calculating the mass of the particle producing the observed track are discussed. As a less probable alternative it is suggested that the track could have been caused by a mesotron or by a proton which was scattered by a nuclear collision very close to the point at which the knock-on collision occurred.

95 A Formulation of a Semiclassical Theory of Multiple Processes by E Clementel and N Dallaporta Nuovo Cimento 5 235-248 (1948) Aug (In Italian)

The Heitler theory for the creation of mesons in proton-proton collision gives an exceedingly high value for the cross section of this process. This feature of the theory is essentially a consequence of the fact that the probability of emission for one meson is greater than one when the impact parameter is small. Following an idea outlined by Bethe (Phys Rev 70 787 (1946)), it is possible to interpret this probability greater than one as the mean number of mesons emitted in a single collision and give

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a simple explanation of the multiple processes. A simple mathematical formalism is developed which makes it possible to calculate the cross sections for processes of every multiplicity. The energy distribution of the mesons emitted is then discussed and the relative orders of magnitude of this new type of multiple processes are compared with those of ordinary quantum-mechanics high order processes. For the meson theory, the new type processes are more important than the ordinary quantum-mechanical ones. The cross sections for the first orders of multiplicity are then numerically calculated following the Moller-Rosenfeld theory. The total cross sections are found to be much smaller than the Heitler cross sections and of the right order of magnitude. 10 references.

96 Further Calculations on the Cascade Theory by H J Bhabha and S K Chakrabarty Phys Rev 74 1352-1363 (1948) Nov 15

Previous cascade theory work is summarized and the mathematical solution of the cascade equations given in previous papers (Proc Roy Soc 181 A 267 (1943); Proc Indian Acad Sci 15 A 464 1942)) is given a more rigorous treatment. This solution has been used to calculate the number of shower particles for thicknesses between 0.25 characteristic unit and 20 characteristic units, and for primary energies from 2.7 times the critical energy ($y_0 = 1$) to 2.7×10^{10} times the critical energy ($y_0 = 24$). The results are tabulated and also shown in curves. These show that the second and higher terms of the series are negligible compared with the first for thicknesses less than three to four times that at which the shower reaches its maximum.

A method has been developed which allows the integrals to be evaluated at very small thicknesses where transition effects are still of importance, so that it is now possible to trace a shower from its very beginning to large depths. It is shown that for very small showers started by particles of two to three times the critical energy the shower must penetrate to depths which are three times the maximum depth to which a single particle could penetrate as a result of collision loss alone. This is possible because part of the path of the shower is covered by photons alone which then materialize at a subsequent depth. Using a simple formula, the spectrum of shower electrons of energy much below the critical energy is calculated. It is shown that this spectrum increases monotonically with decreasing energy at all thicknesses. The relationship is approximately that of a modified inverse square law at the maximum of the shower, the power of the law becoming higher with increasing depth.

97 The Generation of Slow Mesons by G Morpurgo Nuovo Cimento 5 285-291 (1948) Aug (In Italian)

A comparison is made between the intensities of slow mesons (total energy ranging from 1 to 1.5 μc^2), as measured by various authors at different heights, and the intensities theoretically calculated starting from those at superior heights. The losses of energy and the decay of mesons are taken into account. The results obtained make it possible to exclude an appreciable generation of slow mesons "in loco" at least until a height of 4,000 meters. 8 references.

98 The Mass Spectrum of Varitrons by A Alikhanyan, A Alikhanov, V Morozov, G Muskhelishvili and A Khrimyan Zhur Eksptl i Teoret Fiz 18 673-702 (1948) Aug (In Russian)

The new cosmic ray particles discovered in 1946 as reported by Alikhanyan, Alikhanov, and Weissenberg (Zhur Eksptl i Teoret Fiz 18 301-336 (1948) March) were submitted, in the same Mt. Alagez laboratory (3250 m), to a closer study in a mass spectrometer comprising a more powerful permanent magnet (7300 oersted), five groups of counters (two groups above the magnet, three below), and lead filters. The counters were made of copper pipe 0.15 mm and 0.18 mm thick (no glass). The methods of recording the trajectory deviations of particles and of computing their momenta were the same as in the previous work. New diagrams of the radiotechnical equipment are given. The results, presented in distribution curves of particle momenta, show numerous well defined maxima, or spectral lines, corresponding to particles of different masses. The presence of twelve "varitrons" different in mass or charge sign, could be established, both in the hard and in the soft component, the

COSMIC RADIATION AND MESONS (continued)

masses being distributed in the interval between 100 m_e and 25,000 m_e. In the spectrum of the hard component, the steep negative slope of some of the maxima must be interpreted as due to a considerable number of varitrons of a given mass generated, with a maximum momentum, as a result of a disintegration of heavier varitrons which had spent their velocity in the atmosphere. It can also be inferred from these considerations that the half-life of the varitrons is of the same order as that of the mesotron. The presence of rapid protons in cosmic radiation is established by direct measurement, and from the value of the positive excess in the hard component it can be estimated that not less than 7% of the total intensity of cosmic rays must be attributed to rapid protons.

99 Meson - New Atomic Power Source ? by Leonard Engel Science Digest 24 No. 6 53-57 (1948) Dec

The significance of the application of meson studies to basic nuclear theory is discussed. The various types of mesons which have been reported are described. It is suggested that at some future time it may be possible to utilize the energy which would be released by shattering the individual particles of the nucleus; the energy release in such a reaction would be much greater than that released by fission.

100 Methods for Distinguishing the Components of Cosmic Radiation in the Lower Atmosphere and the Relative Frequency of Slow Mesons by G Salvini Nuovo Cimento 5 213-234 (1948) Aug (In Italian)

The author discusses the methods followed until now to distinguish the two principal components of cosmic rays (mesons and electrons) present at low levels. He reports new measurements in which he has tried to compare the two fundamental criteria utilized for this distinction, the one consisting in the distinction of the electrons by their property of cascade multiplication, the other in comparing the different dependence of the absorption from the atomic number of the absorber. The first method has been found the most suitable for the reckoning of the relative number of the slow mesons at sea level. The method consisted of disposing counters through which adsorption curves of cosmic radiation in different elements could be obtained. At the same time it was possible to distinguish the electrons by their property of producing showers in a suitable layer. The causes of errors in this method and similar methods were studied and procedures for eliminating the errors are shown. The errors due to electrons of low energy, which are not subject to cascade multiplication passing through a shower producer and for which the percental loss of energy due to ionisation is not negligible are emphasized. The distinction of electrons by their property of cascade showers production and by measurements at different levels with the same device are particularly uncertain because it implies the knowledge of the energy spectrum of the electrons falling on the telescope.

From these measurements the authors have deduced, up to a moment of 3×10^8 ev/c, the absorption curve of the mesons at Milan (120 m on sea level) and at 2 100 m. The possible causes of error in some previous measurements of the number of slow mesons are discussed. A study was made of how the frequency of slow mesons increases with height. It is concluded that a part of the penetrating particles normally observed as mesons should differ from the ordinary mesons, and this is particularly evident from 3500 m on up. The comparison of the frequence of electrons at Milan and at 2 100 m gives results which agree with the recent results of Bernardini, Cacciapuoti and Querzoli. 18 references.

101 The Multiple Processes in the Hard Components of Cosmic Radiation by E Clementel and N Dallaporta Nuovo Cimento 5 298-310 (1948) Aug (In Italian)

The cross sections, which have been calculated in a previous paper for multiple processes (Nuovo Cimento 5 235-248 (1948)) are applied to the interpretation of proton and meson components of cosmic radiation. The value obtained for the penetration coefficient of the proton component, the energy spectrum of the meson component and the variation of the intensity of this component with the height, are in better agreement with experimental data than the results of the Heitler theory (Revs Modern Physics 17 252 (1945)) which overlooks the possibility of multiple emission of mesons in the proton-proton collision. 11 references.

COSMIC RADIATION AND MESONS (continued)

102 Neutral Decay Products of Cosmic Radiation at Great Depth by J Barnothy and M Forró Phys Rev 74 1300-1310 (1948) Nov 15

The absorption curve of cosmic radiation in a coal mine at a depth of about 1000 m w.e. (water equivalent) was measured over a period of seven years. The shape of the curve and the counter efficiency suggest that the most penetrating component of the cosmic radiation present consists of rays which produce little, if any, ionization. When the counter telescope was inclined at various angles, the intensity decrease was less than that which would be expected for the thickness of the layer traversed. In addition, the radiation intensity was found to vary with the temperature by a mean value of $+0.74 \pm 0.13$ per cent per degree C. The experimental results favor the view that the radiation present at such a depth consists solely of the decay products of mesons. This conclusion is further substantiated by the fact that at 400 m w.e. the exponent in the expression for the intensity as a function of depth increases from 1.8 to 2.8. It is noted that neutral mesons may account for the findings.

103 On a Non-Shower Producing Neutral Component of Cosmic Radiation by Anatole Rogozinski Compt Rend 227 628-630 (1948) Sept 27 (In French)

A horizontal telescope consisting of a set of three counters in triple coincidence and a set of four counters in parallel and in anticoincidence with the first set was used to investigate horizontal cosmic radiation. Tabulated data for anticoincidence frequency as a function of interposed lead plate thickness are shown. The data indicate the existence of a considerable percentage of non-ionizing neutral radiation in the horizontal cosmic radiation. This neutral component interacts with lead more strongly than with the atmosphere. It is suggested that neutrons or neutrettos (neutral mesons) might be responsible for these observations.

104 On the Absorption of Heavy Mesons by the Deuteron by Claude Marty and Jacques Prentki Compt Rend 227 765-767 (1948) Oct 18 (In French)

The process of mesodisintegration of the deuteron, i.e., the absorption of pi-mesons by the deuteron, is discussed. This reaction is suggested as particularly appropriate for a study of the interaction of mesons with nuclei, since the deuteron has been more thoroughly investigated than most nuclei. The following hypotheses were made; (1) the pi-mesons have low kinetic energy, (2) the existence of pseudo-scalar and vectorial pi-mesons in the nuclear force formulation of Moller-Rosenfeld (Kgl Danske Videnskab Selskab 17 fasc.8 (1940)), (3) the wave functions of the deuteron are calculated according to the aforementioned formulation. Hulthen's expression for the radial part of the wave function of the deuteron in the initial state is used (Arkiv Mat Astron Fysik 28A fasc.5 (1942); ibid. 29B fasc 1 (1942)). In the final state, where the energy is practically equal to the rest mass of the incident meson the nucleons are regarded as free, which simplifies the radial wave functions, but necessitates the introduction of a relativistic correction. Neglecting the effect of the Coulomb field, an expression is given for the absorption cross section for a free meson as a function of its kinetic energy. The two constants of the expression depend on the nature of the meson, i.e., vectorial, pseudo-scalar, etc. The effect of the Coulomb field is estimated by the method of Tomonaga and Araki (Phys Rev 58 90 (1940)) for both positive and negative mesons, neutral particles being excluded. The mean life of a pi-meson in the K-shell is determined as 2×10^{-13} sec for a psuedo-scalar meson and 1.3×10^{-13} sec for a vectorial meson. The possibility of mesodisintegration produced by a neutral meson is discussed.

105 On the Atomic Capture of Slow Mesons by B Ferretti Nuovo Cimento 5 325-365 (1948) Aug (In Italian)

The problem as to whether the Conversi-Pancini-Piccioni effect (Phys Rev 71 209 (1947)) is an atomic or a nuclear effect is considered. The probabilities of transition for meson-electron collisions (Auger effect) are calculated for different models both with the use of the Born approximation and of a better approximation. The results of these calculation support the Fermi and Teller conclusions (Phys Rev 72 399 (1947)). 24 references.

COSMIC RADIATION AND MESONS (continued)

106 On the Disintegration of Mesotrons by Kan-Chang Wang and Stanley B Jones Phys Rev 74 1547-1548 (1948) Nov 15 (Letter to the editor)

The disintegration of mesotrons at sea level has been investigated in a cloud chamber containing aluminum sheets with lead plates above and below them and a coincidence counter arrangement. A thick lead block was used to filter out the electron component. The energy of a decay electron emitted by the stopping of a mesotron in one of the aluminum sheets was computed as 52 ± 10 Mev. From the observations it is concluded that either the probability of a mesotron producing a star when it is stopped in aluminum is small, or else the energies of the prongs produced were too small to observe in these experiments. The results obtained do not support the hypothesis of the accelerated decay of negative electrons, but rather favor the hypothesis that some of the negative mesotrons are captured by the aluminum nuclei (Wheeler Phys Rev 71 320 (1947); Valley and Rossi Phys Rev 73 177 (1948); Retallack Phys Rev 73 921 (1948); Ticho Phys Rev 74 492 (1948)), since of the 20 mesotrons observed stopping in the aluminum sheets, 8 gave no decay electrons.

107 On the γ-Decay of the Meson by M Verde Ricerca Sci e Ricostruz 17 2031-2037 (1947) Dec (In Italian)

A calculation is made of the probability for the transition of a vector meson into a pseudoscalar meson with the emission of a γ-ray. If the lifetime of the heavier meson $\simeq 10^{-8}$ seconds, then the coupling of one of the meson fields with the nucleons must be fairly weak to fit experimental facts.

108 On the Range of Decay Electrons from Mesons by M H Shamos and A Russek Phys Rev 74 1545-1546 (1948) Nov 15 (Letter to the editor)

Information regarding the range of decay electrons in carbon has been obtained using the slow meson detector previously described (Shamos and Levy Phys Rev 73 1396 (1948)). Earlier data taken by numerous investigators have cast doubt on the hypothesis of a unique decay energy; some of these data indicate a continuous distribution while others seem to indicate superposition of a continuous distribution on a unique range. The apparatus used and the curves of yield as a function of adsorber radius for unique ranges of 10,12,16, and 20 g/cm^2 are shown, i.e., theoretical yield curves. It was found that the data obtained are not consistent with a unique range, the mean range tending to increase with the absorber radius. The experimental results agree with those of Steinberger (Phys Rev 74 500 (1948)) and Hincks and Pontecorvo (Phys Rev 74 697 (1948)) insofar as they indicate an apparent distribution of electron energies. However, it is noted that the results obtained would also be consistent with a spectrum consisting of two discrete energies of about 20 Mev and 45 Mev. The mean range and form of the distributions could not be determined from the data due to the uncertainty in the fraction of negative mesons captured in carbon.

109 On the Variation with the Rate of Frequency of Nuclear Evaporation in Photographic Plates by A Persano Nuovo Cimento 5 292-297 (1948) Aug (In Italian)

A comparison is made between the experimental results obtained examining 3 Ilford plates sent to 17 km in the atmosphere with flying ballons, and 2 similar plates exposed for 43 days at 3,500 m (Laboratorio Testa Grigia). Assuming an exponential absorption of the radiation responsible for the observed phenomena, the deduced mean free path is $\lambda = 141 \pm 12$ g/cm^2. Using the Gross transformation, $\lambda = 176 \pm 14$ g/cm^2 was obtained. In both cases the error, taking into account the statistical fluctuations only, is likely lower than the real one. However, a good value for the mean free path seems to stay between 130 and 180 g/cm^2. A discussion is presented comparing the author's results with those of other authors by the same or by different techniques. 5 references.

110 The Penetrating Particles in Cosmic-Ray Showers: I. Heavily-ionizing Particles by G D Rochester and C C Butler Proc Phys Soc 61 307-312 (1948) Oct 1

The heavily-ionizing particles which occur in cosmic ray showers were studied by use of counters in five-fold coincidence in conjunction with a cloud chamber. The majority of such particles were found to be protons, while a small number were identified as slow mesons. Examples of the local

COSMIC RADIATION AND MESONS (continued)

creation of mesons in explosive showers were noted and the particles identified as mu-mesons. These results are consistent with the recent discovery of Gradner and Lattes (Science (1948) Mar 12), that mu-mesons may be created directly and are not always the disintegration products of pi-mesons as suggested by Marshak and Bethe (Phys Rev 72 506 (1947)). Cloud chamber photographs of tracks produced in the various reactions studied are shown.

111 Penetrating Power of Extensive Shower Particles by G T Reynolds and W D Hardin Phys Rev 74 1549-1550 (1948) Nov 15 (Letter to the editor)

The penetrating power of extensive shower particles in lead has been investigated. An extensive counter was first selected by two Geiger counter trays and then analyzed by means of six other Geiger counter trays under various thicknesses of lead. A "cathode-gate circuit" (Kurshan Rev Sci Instruments 18 647 (1947)) enabled sampling of extensive showers. Data obtained for the number of counts per hour observed in the various counter trays as a function of lead thickness are given. A transition effect observed as the lead was increased from zero to 2 cm was attributed to increased effective efficiency of the counters due to local shower production immediately above the tray. A break in the curve in the vicinity of 15 cm of lead is interpreted as indicating the presence of two components in the showers. An analysis of the data is in progress to determine an upper limit to the cross section for the photo-meson process produced by the gamma rays in extensive air showers.

112 Protons as Cosmic Ray Primaries. I. by K H Höcker Z Physik 124 351-391 (1948) (In German)

The cross section for meson forming collisions and the energy transfer occurring at such collisions has been correlated with the observed altitude variation of the hard and soft components of cosmic radiation and with the latitude effect; the main soft component at high altitude was referred to the decay of a meson having a half-life of the order of 10^{-8} sec. In making these calculations it was assumed that the cosmic ray primaries are protons and also that protons of energy greater than 3×10^9 ev give meson formation in collision with nuclei. The cross section value obtained is 2.2×10^{-26} cm^2 with an estimated 1/4 of the energy passing to the meson field.

113 Protons as Cosmic Ray Primaries. II. K H Höcker Z Physik 124 392-420 (1948) (In German)

The theoretical picture presented in Part I is compared with the experimental results obtained by Schein and his co-workers (Phys Rev 64 253-254 (1943) Oct 1 and 15). As an alternative it is suggested that by means of small energy transfers the protons may result in the production of neutrettos; the neutrettos may either decay to neutrino pairs or lead to mesons by means of a further collision process. Assuming neutretto formation, a cross section is determined which is in agreement with the observed production of penetrating secondaries in paraffin at high altitudes. The results obtained are discussed with respect to the existence of the π-meson.

114 A Search for Delayed Photons from Stopped Sea Level Cosmic-Ray Mesons by R D Sard and E J Althaus Phys Rev 74 1364-1371 (1948) Nov 15

If the meson disintegrates into a photon and an electron, the stopping of a meson and its subsequent decay should give rise to a delayed 50-Mev photon. Delayed coincidences were sought between the stopped meson and the photon, detected by its materialization in a Pb sheet (calculations are presented of the photon detection efficiency for various lead thicknesses and photon energies of 20, 40, and 60 Mev; the electron range-energy curves used in the calculation are also shown). In 477.4 hours, nine apparent delayed photon coincidences were found. The measured inefficiency of the anticoincidence arrangement led the authors to expect five spurious delayed photon coincidences in this time; so it was concluded that the number of true delayed photon coincidences is small, if not zero. If the hypothesis under test is correct, the expected number of true delayed photon coincidences, computed from the rate of delayed electron coincidences (as measured with the same geometry) and the calculated photon detecting efficiency, is of the order of 100. The negative result of this test argues not

COSMIC RADIATION AND MESONS (continued)

only against decay into a photon and an electron, but also shows that if meson decay leads to a neutral meson which then decays into two photons, the mean life against the latter process must be greater than about 10^{-10} sec. Diagrams of the counter arrangements and circuits are shown along with calculated range-energy and probability curves relevant to the experiments. Calibration and correction data are tabulated in addition to the coincidence data.

115 The Semi-Diurnal Variation in Cosmic Ray Intensity by Phyllis Nicolson and V Sarabhai Proc Phys Soc 60 509-523 (1948) June 1

The experimental data on the daily variation in cosmic-ray intensity are first surveyed. It appears to be established by Ray's experiments (Z Physik 114 265 (1939); ibid 116 105 (1940)) that the energetic meson component at sea level shows a marked semi-diurnal variation which is in phase with the semi-diurnal variation shown by the barometric pressure. Several authors have suggested that this phenomenon is explicable in terms of the Pekeris theory of atmospheric oscillations (Proc Roy Soc 158A, 650 (1937); ibid 171 634 (1939)). The implications of this explanation on the process of meson formation are examined quantitatively. It is concluded that the explanation is only possible if mesons arise mainly at about 60 or 70 km above sea level, which is highly unlikely since the corresponding cross-section for meson production would be much larger than appears plausible. In addition the experimental data on the diurnal variation are briefly discussed. This variation seems to be more complicated in character than is usually assumed and not attributable to factors such as a heliomagnetic field and fluctuations in the geomagnetic field which are often held responsible. 26 references.

116 The Temperature Effect on Cosmic-Ray Intensity and the Height of Meson Formation by A Duperier Proc Phys Soc 61 34-40 (1948) July 1

A study has been made of the results of observations made in different parts of the world of the effects of ground temperature on cosmic-ray intensity. It is found that the great discrepancies between the values for the temperature coefficient as given by different observers, as well as the seasonal change of this coefficient, far from being a difficulty in Blackett's interpretation (Phys Rev 54 973 (1938)) may be taken as further evidence of the instability of the meson. The 12-monthly variation in cosmic-ray intensity as obtained by Forbush (Phys Rev 54 975 (1938)) can be also accounted for as an effect of meson decay if one assumes that the bulk of the penetrating component originates at 7.5 cm Hg pressure-level. This assumption has been put to the test and the results obtained appear to confirm that the layer of meson formation lies at, or little above, the 7.5 cm pressure-level, at the height of the maximum of the Pfotzer curver (Z Physik 102 23 (1936)) for the intensity of the total radiation. 15 references.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

117 Distribution of Electron Density in Copper Lattice by V K Kritskaya and B M Rovinskii Zhur Eksptl i Teoret Fiz 18 785-789 (1948) Sept (In Russian)

An investigation is made on the possibility of using Fourier series for a quantitative study of the distribution of electron density in the crystal lattices of metals.

118 Divergent Beam X-Ray Photography with Standard Diffraction Equipment by A H Geisler, J K Hill and J B Newkirk J Applied Phys 19 1041-1049 (1948) Nov

Schematic diagrams of the apparatus and the principles involved in using the method are given. Laue patterns and stereographic projections calculated from patterns obtained for different crystals under various conditions are shown. Tabulated data on the location of critical points in patterns of cubic materials as functions of wavelength and lattice parameter are presented.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (continued)

119 The Effect of Temperature on X-Ray Measurements by Viktor Hauk and Eugen Osswald Z Metallkunde 39 190-192 (1948)

The authors determined correction factors for lattice constants of Au and Ag between 60° and 184° using Co, Cr, and Cu radiations.

120 Electron Microscope Goniometry by A F Kirkpatrick and Evelyn Gagnon Davis Analyt Chem 20 965-968 (1948) Oct

The frequent occurrence of unknown crystals in electron microscopical samples presents the problem of their identification. Their relatively small size severely limits the ordinary methods of identification. The silhouette angles observed on the screen or photographic plate are practically all the data available to the electron microscopist. These angles are functions of the interfacial angles of the crystals and the orientation with respect to the screen or plate. The interfacial angles, constants of a suspected compound as obtained from the literature, can be used to calculate the angles of an orthographic projection of the crystal, which is observed with the electron microscope. A comparison of the angles measured with those calculated may establish the identity of the crystal. It may be possible to determine directly axial elements (axial ratios and interaxial angles) and interfacial angles of unknown crystals. This represents the determination of physical constants with the electron microscope. The authors use the calcite crystal as an example and present a table of results.

121 The Influence of Hardness on the Change in Texture Produced by Working, on Crystal Surfaces by K H Leise Z Physik 124 258-263 (1948) (In German)

Using electron diffraction methods, the effect of polishing upon the texture of non-metallic single crystal surfaces was investigated; the results obtained are discussed with respect to hardness of the polished material. The crystals of LiF, NaCl, and KBr were investigated, among others. It was noted that the harder crystals still gave single diffraction patterns after polishing, whereas the softer crystals gave powder patterns exhibiting diminishing evidence of preferred orientation with increasing softness of the material. For the softer materials the crystal structure was disturbed to a greater depth. The author does not agree with the conclusions of Finch (Nature 138 1010 (1936)), and states that the Beilby hypothesis of a fluid-like surface layer on insulator surfaces is not confirmed.

122 A Numerical Fourier-analysis Method for the Correction of Widths and Shapes of Lines on X-ray Powder Photographs by A R Stokes Proc Phys Soc 61 382-391 (1948) Oct 1

A method is derived, using Fourier analysis, for finding the corrected distribution of intensity across an x-ray diffraction line by allowing for "instrumental" broadening. The procedure is illustrated by a numerical example. The method may also be of use in spectrum analysis and statistical problems.

123 On a New Type of Rotating Anode X-Ray Tube by A Taylor Proc Phys Soc 61 86-94 (1948) July 1

A brief account is given of the physical limitations which influence the power output of stationary and rotating anode x-ray tubes used in crystallographic work. Brief mention is made of various tubes which incorporate rotating vacuum seals in the anode assembly. An account is then given of the "Peristron", a continuously water-cooled rotating anode x-ray tube which completely dispenses with the need of rotating vacuum seals. Incorporated in the tube is a novel type of cathode assembly which permits of rapid adjustment to the focus from outside the vacuum envelope. 18 references.

124 X-Ray Diffraction Film-to-Specimen Gauge by E P Warekois Rev Sci Instruments 19 607 (1948) Sept

A simple gage that allows a rapid and accurate setting of the film-to-specimen distance while taking an x-ray diffraction picture is described. The dimensions are indicated on a diagram and a photograph of the device is also shown.

FLUOROCARBONS

125 The Action of Aluminum Chloride on Chlorofluorocarbons by W T Miller Jr, E W Fager and P H Griswald. AECD-2401 nd, Decl Nov 29 1948 7p Proposed for publication in J Amer Chem Soc

Aluminum chloride has been found to cause rearrangement as well as replacement of fluorine by chlorine, when reacted with chlorofluorocarbons. The rearrangement reaction leads to the formation of compounds containing trifluoromethyl groupings.

126 Aliphatic Fluorine Compounds by E B Towne Org Chem Bull 20 No.2 1-4 (1948)

The author discusses the rapidly expanding field of aliphatic fluorine chemistry which has been especially pronounced as a result of war demands for the thermally stable, chemically inert organic compounds of fluorine. This inertness is in sharp contrast to the explosive reactivity of fluorine itself with organic compounds. The freons (commercial refrigerants) were developed several years ago, and Tefon, the new resistant tetrafluoroethylene polymer, is a recent development. New methods in the preparation of acids, amines, ethers, etc., have been described. The addition of hydrogen fluoride to olefins and acetylenes has several commercial uses. Among the new developments described are the fluorine cell, which makes fluorine readily available for the first time, and new methods have made possible the preparation of many fluorocarbons, such as perfluoroheptane, C_7F_{16} which were unheard of previously. The use of fluorocarbons as high-temperature lubricants, insulating fluids and in preparing polymers is anticipated. Selected examples of the preparation of aliphatic fluorine compounds are given, as well as a brief description of their general properties and uses.

127 The Development of Fluorine Chemistry by H J Emeleus Endeavour 7 No.28 141-147 (1948) Oct

The development of fluorine chemistry is traced from the studies of Davy 1808-1816 up to the present. A greater portion of the article is devoted to a discussion of the methods of producing and properties of the fluorocarbons. 13 references.

128 Fluorination of Organic Compounds with Anhydrous Hydrogen Fluoride. Part I. The Preparation of Fluoroform and Certain Derivatives by W B Whalley J Soc Chem Ind 66 427-430 (1947) Dec

The radical $-CCl_3$ was converted with almost quantitative yields to $-CF_3$, in chloroform, carbon tetrachloride, tetrachloroethane, and methyl chloroform, by using antimony pentachloride as the catalyst and anhydrous HF. Tables of respective yields are listed. 9 references.

129 Fluorination of Organic Compounds with Anhydrous Hydrogen Fluoride. Part II. An Investigation of Antimony Pentachloride Catalysed Fluorinations by W B Whalley J Soc Chem Ind 66 430-433 (1947) Dec

A detailed investigation was made of the fluorination of sym-tetrachloroethane, and pentachloroethane, and as-tetrachloroethane, using antimony pentachloride and anhydrous hydrofluoric acid. The catalyst concentration was varied and results are given in tabular form as well as in graphs. The catalyst gave trace yields of monofluoride and also yielded coke and difluorides. For the production of monofluoride, a milder catalyst, stannin chloride, was used successfully. It is seen from the curves that the extent of mono- and di-fluorination varies markedly with catalyst concentration. 8 references.

130 Fluorination of Organic Compounds with Anhydrous Hydrogen Fluoride. Part III. Uncatalysed Fluorinations by J H Brown and W B Whalley J Soc Chem Ind 67 331-333 (1948) Aug

Hydrogen fluoride was used without catalyst in fluorinating carbon tetrachloride, tetrachloroethane, pentachloroethane, and hexachloropropylene. The fluorinations are performed at high pressures and are very likely heterogeneous gas reactions. Results are given in tabular and curve forms, and the reaction mechanism is discussed.

FLUOROCARBONS (continued)

131 Infra-red Spectra of Fluorinated Hydrocarbons. Part II. "Methyl Fluoroform" (1:1:1-Trifluoroethane) by H W Thompson and R B Temple J Chem Soc 1948 1428-1432 (1948) Sept

Thermodynamic properties of methyl fluoroform have been estimated by determining the infra-red absorption spectrum between 2 and 20μ and assigning vibrational frequencies. Comparing the calorimetric value of entropy with the statistically calculated one shows the existence of a potential barrier of 3250 cals resisting free rotation of the end groups with respect to each other.

132 No Free Fluorine Chem Inds 63 765-766 (1948) Nov

J. H. Simon's electrolytic process for fluorinating organic compounds is being developed in a pilot plant by the Minnesota Mining and Manufacturing Co. It consists essentially of passing a current through HF and the organic compound. The principal product being a fluorocarbon with the same number of carbon atoms as the starting material.

133 The Vapor Pressure of Benzotrifluoride Measured by the Rodebush Manometer by G W Sears and E R Hopke J Phys and Colloid Chem 52 1137-1142 (1948) Oct

Some salient factors limiting the operation of the Rodebush manometer are discussed. The vapor pressure of solid benzotrifluoride was measured over the range -51°C to -40°C. The vapor-pressure equation was calculated by the method of least squares. The heat of vaporization of solid benzotrifluoride was calculated to be 12,990 cal/mol. A corresponding calculation using Saylor and Fields' data (J Amer Chem Soc 68, 2649 (1946))gave 10,460 cal/mol as the heat of vaporization of liquid benzotrifluoride at its melting point. The heat of fusion was found to be 2520 cal/mol. The entropy of fusion was 10.3 E.U. 9 references.

134 Vapor Pressure of Methyl Fluoride by A Michels and T Wassenaar Physica 14 104-110 (1948)

Vapor pressure data are given for methyl fluoride between -110° and +15°. The vapor pressure equation given is $\ln P = (A/T) + B\ln T + C$, where A = -2399.734, B = -1.541142, C = 20.43826, T = °K, P = pressure in atmospheres. Values of P experimental are listed versus P calculated.

135 The Vibrational Spectra and Thermodynamic Properties of Chlorofluoromethanes by H W Thompson and R B Temple J Chem Soc 1948 1422-1428 (1948) Sept

In order to compute certain thermodynamic properties, the authors have measured the infra-red absorption spectra of chlorotrifluoromethane, trichlorofluoromethane, dichlorodifluoromethane, and dichlorofluoromethane. The results were correlated with Raman spectra, vibrational frequencies were assigned, and the properties calculated. Tables of experimental and calculated results are given.

HEALTH PROTECTION

136 The Effects of Atomic Bombs on Health and Medical Services in Hiroshima and Nagasaki. United States Strategic Bombing Survey Mar 1947 91p

This report briefly outlines the immediate and remote measurable effects of the atomic bombs and the subsequent widespread fires on the health of the civilian population. The investigation includes the different phases of public health following the outline used in the over-all health survey of Japan. This report contains chapters which relate to medical and health facilities and services, nature of air raid casualties, sanitary facilities and services, food supply and nutrition, communicable diseases, and industrial health and hygiene. Included are photographs showing damage done to various medical facilities and injuries sustained by persons within the bombed areas.

HEALTH PROTECTION (continued)

137 Effects of New Forms of Energy on Industry and Medical Service by Jean Spencer Felton Occupational Med 5 73-77 (1948) Jan

With the introduction of nuclear energy into industry new concepts of occupational health have been adopted to protect the worker against the hazards of his job. Special services include the health-physics department and the health divisions. The first supervises personal monitoring, renders a survey service in measuring the amounts of radioactivity present in the air and attends to special research and development problems which may arise. The health division makes complete and frequent physical examinations of the worker, makes wax finger ridge impressions of personnel in contact with active materials, follows individual workers long after exposure, handles morale problems, keeps itself informed on the toxicity of new materials, constantly reviews exposure records and clinical records and maintains an educational program to train personnel in the recognition and handling of specific hazards. The medical director must familiarize himself with protective clothing, procedures to be followed in contamination of personal clothing, venilation systems, certain regulations which must be enforced in the laboratories using radioactive materials and methods of disposal of liquid and solid wastes. A recommendation is made that the entire code of occupational illness laws undergo revision, for at the present time there is not a single occupational disease law that carries with it a statute of limitations that will protect the worker who believes he has been damaged by exposure to toxic rays.

138 Nuclear Fission Developments Pose Sanitary-Engineering Challenge Eng News-Record 141 No.16 91-92 (1948) Oct 14

The role of the sanitary engineer in protecting man and his environment against hazards of radioactivity was discussed by Abel Wolman and Arthur E. Gorman at a recent meeting. Particular emphasis should be placed by sanitary engineers on groundwater protection, disposal of radioactive wastes, sewers and pipes, and problems of water supply and disposal.

INSTRUMENTS

139 On All-Glass Filtration Apparatus for Radioactive Tracer Experiments by Jacob Sacks. Brookhaven National Laboratory Report BNL-T-4 nd 7p

An all-glass apparatus has been devised which retains the advantages of Gooch crucible technique, and has the added advantage that the parts may readily be separated and cleaned. The essential unit consists of a filter tube with a flat ground surface to receive the modified crucible, equipped with a standard taper ground joint and side arm for attachment to a suction pump. The receiver is an Erlenmeyer flask with a 24/40 standard taper ground joint neck. The lower portion of the crucible is shortened and the edge ground to fit on the flat surface of the filter tube. The filtration assembly is shown in a sectional diagram. An application of the apparatus with reference to an experiment with acid-soluble P compounds of liver is described.

140 Electron Lenses of Hyperbolic Field Structure. Part II by Reinhold Rudenberg J Franklin Inst 246 377-408 (1948) Nov

The effects of increasing the lens voltage of an electron lens to a value exceeding that of the incident electrons are discussed. The initial effect is to block the beam; at higher voltages, however, the electron lens is converted, in effect, into a curved mirror. The focal properties of such a mirror are analyzed, and the field equivalent of a hyperbolic lens is discussed in terms of boundary conditions which can be rigorously or approximately satisfied in actual designs. The effects of lateral apertures and windows on the imaging qualities of the field are given detailed consideration. Expressions are derived for the angular, hyperbolic, and velocity aberrations which should be taken into consideration in designing a hyperbolic electron lens. These aberrations are found to be of relatively small magnitude; all three are dependent on a few parameters of the lens field. An experimental verification of the field structure, in which the aberrations had been partially compensated for, demonstrated the satisfactory imaging properties of such a system. Similar expressions are

INSTRUMENTS (continued)

formulated for the case of a two-dimensional field which can be used as an electron cylinder lens. 28 curves and diagrams.

141 Electron Microscopy - A New Method of Making Slides by P Dinichert and E Kellenberger Experientia 4 407-408 (1948) Sept 15 (In French)

An apparatus is described for dissolving the plastic material on which a silica film has been deposited for electron microscopy replica technique. A diagram of the apparatus is included.

142 Electronics and Their Application in Industry and Research, edited by Bernard Lovell. London, The Pilot Press Ltd 1947 660p

An account of developments in electronics during England's war years is given by several authors. A 100-page description of electron microscopy and electron diffraction is included, along with a discussion of the various tube types and electronics applications.

143 Graphite Bearings for Mechanical Stirrers by Henry David Baldridge Jr Science 108 502-503 (1948) Nov 5

A laboratory stirrer has been developed having graphite bearings placed at strategic points in the mercury seal. This stirrer requires minimum attention, is simple to assemble, is self-lubricating, has great durability, and has the advantage of chemical inertness of the bearings. A cross section of an assembly with three sets of bearings is given.

144 High Precision Ultramicroburet by Roger Gilmont Analyt Chem 20 1109-1111 (1948) Nov

An ultramicroburet which may be used for liquids and gases and which may be adapted to automatic measurements with only slight modifications is described in detail, and cross section drawings of it are presented. The essential feature of this buret is the plunger which enters a mercury reservoir through a rubber gasket and the motion of which is measured by a dial micrometer gage that reads directly in volumetric units.

145 An Ion Microscope with a Transverse Magnetic Field by Nobuji Sasaki J Applied Phys 19 1050-1053 (1948) Nov

A brief discussion of electron and ion microscopes is presented followed by a description of a low magnification, electrostatic ion microscope. This instrument is of the emission type in which the source of positive ions is imaged. If more than one kind of ion is emitted, the images corresponding to the various atomic weights may be separated by means of a transverse magnetic field and the ratios of the atomic weights calculated from the displacements. The possible applications of the instrument are discussed. Some ion source images obtained by this method are shown.

146 Microscope Hot Stage by F W Matthews Analyt Chem 20 1112-1115 (1948) Nov

A new type of a microscope hot stage for the determination of melting points is described in detail. A small heating block placed inside a water jacket allows fast heating and cooling and an electric circuit provides excellent control of the rate of heating as well as the temperature gradient at the melting point. Pictures and drawings are given, as are characteristic curves for the heater.

ISOTOPES

147 Natural Abundance Measurements on Germanium by R F Hibbs, J W Redmond, H R Guinn and W D Harmon. AECD-2393 (Y-210) Aug 3 1948 Decl Nov 30 1948 3p Proposed for publication in Phys Rev

This is not an abstract; the document is reproduced below in its entirety.

In conjunction with the electromagnetic separation of stable isotopes at the Y-12 Plant of Carbide and Carbon Chemicals Corporation, Oak Ridge, Tennessee, it became necessary for the Assay Laboratory Department to develop methods for the routine isotopic analysis of enriched germanium

ISOTOPES (continued)

samples. Review of the literature failed to reveal recent measurements of the natural isotopic composition of this element, and the results of Aston's (Mass Spectra and Isotopes, p. 154, Edward Arnold and Company, London, 1944) work are shown in Table I. To check the reproducibility of the method and to provide more accurate data on the natural composition, these values were redetermined.

For the routine method, the compounds used had to be reliably prepared from small quantities of material, yielding a reproducibly pure product. Germanium tetraiodide and germanium tetrafluoride met these requirements. The tetraiodide was distilled through a heated delivery tube, and germanium tetrafluoride was admitted into the instrument through a capillary leak. Ionization in the Nier type mass spectrometer was accomplished by slow electron bombardment of the vapors. The ions thus formed were accelerated by a potential of 2000 volts and separated with the conventional sector magnet. The resulting ion currents were measured with an FP54 electrometer tube, balancing the potential developed across the grid resistor with a potential from a precision potentiometer. The ion currents were also recorded by use of a Victoreen VX-41 electrometer tube, driving a standard Brown Electronik Recorder. The vacuum was approximately 5×10^{-7} mm of Hg, and the resolution in all cases was perfect.

In the case of the tetrafluoride, the measurements were made upon the GeF_3^+ ion, and the GeI^+ ion was used form measurements when the tetraiodide was distilled into the instrument. The results obtained with these compounds are shown in Table I.

Table I

Mass	70	72	73	74	76
GeF_3	20.60	27.38	7.83	36.40	7.78
Mean Deviation	±0.06	±0.08	±0.06	±0.10	±0.05
GeI	20.65	27.43	7.86	36.34	7.72
Mean Deviation	±0.04	±0.02	±0.04	±0.05	±0.01
Aston	21.2	27.3	7.9	37.1	6.5

The abundances, using GeF_4, are the result of three samples in two instruments and the GeI_4 measurements of two samples in one instrument. It was found that variations between instruments and between ion sources in the same instrument were larger than variations between samples. Investigation of the mass region, adjacent to the measured ions, revealed it exceptionally free from interfering ions of other materials.

148 Inventory of Stable Isotopes, Nov 1948 by C P Keim, H W Savage and B S Weaver. Carbide and Carbon Chemicals Corporation Y-12 Plant Report Y-274 Nov 8 1948 38p

This inventory lists the stable isotopes which have been electromagnetically concentrated, along with the completed information on their enriched abundances, and the element weights and product forms available in milligram quantities to both Atomic Energy Commission users and others.

149 Natural Abundance Measurements on Potassium and Magnesium by R F Hibbs and J W Redmond. Carbide and Carbon Chemicals Corporation Y-12 Plant Report Y-290 Nov 24 1948 5p

Natural abundance measurements were made on potassium and magnesium, using a conventional 60° mass spectrometer. Analysis of potassium ions formed thermally gave the abundances K^{39} 93.25%, K^{40} .010% and K^{41} 6.75%. Measurements on magnesium from magnesium iodide indicated the composition Mg^{24} 78.98%, Mg^{25} 10.05% and Mg^{26} 10.97%.

ISOTOPES (continued)

150 Oxygen Isotopes in Nature and in the Laboratory by Harold C Urey Science 108 489-496 (1948) Nov 5

The author first reviews the general topic of isotopes, discussing their various uses. He then describes processes involving deposition of oxygen in calcium carbonate deposited by animals. Noting that the ratio of the oxygen isotopes in calcium carbonate varies with the temperature, the author states that a new thermometer of great durability exists, which may have been buried in the rocks for hundreds of millions of years after recording the temperature of some past geological epoch, assuming that the compound remains unchanged once buried. Due to the extremely small temperature coefficient, however, an extremely precise mass-spectrometric method is necessary. The author and his collaborators modified the mass spectrometer to give a ratio measurement to 0.0176%. In an attempt to develop pure enough carbon dioxide for the instrument, the author found that a mixture of phosphoric acid and phosphorus pentoxide would react with calcium carbonate to yield an extremely pure gas. In order to obtain a temperature scale for the purpose of empirically establishing a relationship between the isotopic composition of the shells of present-day animals and the temperature at which they live, the author collected specimens and plotted the temperatures at which the animals live against the isotopic composition. The points follow a straight line rather well, and it is seen that many organisms do fit the theoretical curve expected on the assumption that the calcium carbonate deposited is in equilibrium with the sea water. The author's conclusion is that while the data thus far may not be sufficient to draw extensive conclusions in regard to past geological temperatures, they are sufficient to lead to the belief that some quantitative basis for past climatic conditions of the earth may be secured.

151 The Relative Abundance of the Zinc Isotopes by D C Hess Jr, M G Inghram and R J Hayden Phys Rev 74 1531-1532 (1948) Nov 15 (Letter to the editor)

This article is based on AECD-2209. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. I-956.

152 The Varieties, Quantities, and Purities of Stable Isotopes Which Have Been Concentrated Electromagnetically by C P Keim Science 108 541 (1948) Nov 12

This article is based on AECD-2116. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. I-644.

ISOTOPES SEPARATION

153 The Enrichment of the Heavy Isotopes of Li and K by Electrolytic Ion Migration in Fused Chlorides by Von Alfred Klemm, Heinrich Hintenberger and Philipp Hoernes Z Naturforsch 2 245-249 (1947) May (In German)

K was greatly enriched by electrolytic migration at the boundary between fused LiCl and 2 mol percent KCl on one side and fused $PbCl_2$ on the other, with a current density of 5 A/cm^2 for 48 hours. The mixture ratio of Li^7/Li^6 was changed from 12.3 to 44.3 and K^{41}/K^{39} from 0.0714 to 0.0885. The quotients of the rate of ion migration were found to be $w_{Li}/w_K = 1.156$, $w_6/w_7 = 1.021$ and $w_{39}/w_{41} = 1.016$. If these quotients are accepted as the separation factor for each step, then the enrichments cited above represent effective total separation steps of 61.5 for the Li isotopes and 13.4 for the K isotopes. For the mass effect $\mu = \ln(wj/w_k)/\ln(m_j/m_k)$ (m = isotopic mass), $\mu = -0.135$ for Li and $\mu = -0.32$ for K. The large mass effect and small separation step for K can be explained as being due to its low concentration.

154 Isotope-Concentration through Ion-Migration in Water-Solution, Liquefaction, and Solid Phase by Torbjörn Vestermark Teknisk Tidskrift 78 160-162 (1948) Mar 13 (In Swedish)

Experimental investigations of Lindemann's relation $\frac{v_L}{v_t} = \sqrt{\frac{M_t}{M_L}}$ for the mobility of

ISOTOPES SEPARATION (continued)

isotope ions in solution, moving under the influence of an electric field (Proc Roy Soc 99 A 103 (1921)) are reviewed. (The subscripts "L" and "t" refer to the light and heavy isotopes respectively, "M" and "v" corresponding to mass and velocity.) Brewer, Madorsky and Westhaver (Science 104 156 (1946)) found that such an effect does exist for potassium ions. Numerous investigators have since demonstrated the isotopic effect for ion-migration exists in both the solid and liquid states.

Investigations of this effect in the solid and liquid states which were made by Klemm (Naturwissenschaften 32 69 (1944); Z Naturforsch 1 252 (1946); 2 a 9 (1947); 2 a 245 (1947)) are discussed in some detail. The ratio between the migration velocities of the isotope ions of Ag^{107} and Ag^{109} was determined as 1.002; the ion retention was verified by the mass spectrograph as well as by neutron-induced radioactivity of Ag^{108} and Ag^{110} (Flammersfield and Bruna, Naturwissenschaften 32 70 (1944)). Further work with the heavy alkali isotopes in the liquid state gave a ratio between the velocities of the Li^6 and Li^7 ions of 1.021; according to Lindemann's formula this should be 1.075. For the velocity ratio of K^{39} to K^{41} a value of 1.016 was obtained as compared with the 1.025 predicted by the Lindemann expression. Comparing these values with those obtained by Brewer, it is found that a larger concentration effect is observed for the liquid-state data as compared with that for water solutions. The necessity for further work on the following aspects of this subject are suggested: Influence of hydration, application to heavy metals, adaptation to separation of chemically different ions. The separation of radium from barium and the production of rare earths by this method are also suggested.

MASS SPECTROGRAPHY

155 A Mass Spectrograph for the Determination of Isotope Abundances by W Paul Z Physik 124 244-257 (1948) (In German)

A mass spectrograph consisting of a 60° magnetic sector, a Heil-type ion source, and a Faraday cage is described in detail and diagrams of the apparatus are shown. The following are cited as favorable characteristics of this instrument: 1) mass numbers ≤ 350 can be determined with a resolving power of 500; 2) the instrument can be cleaned by baking; 3) small samples of the order of a few mg can be used; 4) the error in the relative abundance determined by this instrument should be $\simeq 1\%$.

156 Theory and Application of Trochotrons by H Alfven, L Lindberg, K G Malmfors, T Wallmark and E Astrom. Stockholm, Kungliga Tekniska Hogskolans Handlingar No.22 1948 106p

The theory and application of trochotrons, i.e., electronic tubes which utilize the fact that the path of an electron in a slightly inhomogeneous field is a trochoid, are discussed in the following collection of papers: On Trochoidal Electron Beams, by Hannes Alfvén; Design and Properties of Trochotrons, by Torkel Wallmark; Design of Trochotron Circuits, by Lennart Lindberg; Experimental Investigation on an Electron Gas in a Magnetic Field, by Ernst O. Astrőm; On the Instability of an Electron Gas in a Magnetic Field, by Karl Gustav Malmfors.

METALLURGY

157 The Contribution of Modern Physics to Metallurgy by Frederick Seitz J Applied Phys 19 973-987 (1948) Nov

The author reviews the contributions which the comparatively recent development of atomic theory has made to the theory of metals. Following a general discussion of the most recent quantum mechanics picture of atomic structure, the structure of metals is discussed and atomic radii as functions of atomic number are shown graphically for the various elements. The electrical, mechanical, and magnetic properties of metals, the source of metallic cohesion, and the phenomenon of migration of atoms in metals are also treated. Schematic lattice diagrams and other diagrammatic material are given.

METALLURGY (continued)

158 Current Trends in Powder Metallurgy by Walter F Toerge Steel 123 No.21 73-80 and 111-112 (1948) Nov 22

The various steps in making parts from metal powders are discussed. The production of metal powders of titanium, tantalum, zirconium, vanadium, chromium, molybdenum, nickel and manganese are briefly explained.

159 A New Adhesive for Metals by C J Moss Aeroplane 75 423-425 (1948) Sep 24

Exacting requirements for surface smoothness and structural strength of modern high-speed aircraft has resulted in producing "Araldite", a process for bonding metals. Araldite will make strong joints between metals with the application of pressure from 1 to 200 psi. It lends itself to making lap joints between tubes which fit reasonably well together. It is the only adhesive which will provide good bonding between glass, mica and porcelain and metal, and will be of use in the manufacture of aircraft instruments. Araldite is also available as a surface coating and as a casting resin. The surface coating has good resistance to acids, alkalies, oils, solvents and water and it can be used either as clear or as pigmented finish. Detailed information on bonding, heat treatment, properties of joints and shear strength is given along with graphical and listed data.

160 Progress Report for July, Aug and Sept 1948 by R Smoluchowski. Carnegie Institute of Technology Report CAR-1 Oct 1 1948 11p

Results of studies of stability of orientation of grain boundaries in columnar copper, grain boundary diffusion in Cu-Ag system, design of an x-ray camera for small angel scattering, and a theoretical study of clustering phenomena in solid solutions are reported.

161 Quarterly Progress Report No. 8 on the Development of the Physical and Chemical Properties of the Sodium-Potassium Alloy by Curtis T Ewing, Robert E Seebold, Joseph A Grand and Harold B Atkinson Jr. Naval Research Laboratory Report NRL-C-3330 Aug 9 1948 8p

The report presents the status of active property measurements of sodium-potassium alloys. Three pieces of apparatus are described which are used in measurements of specific heat, thermal conductivity, and surface tension respectively. A preliminary report of the determination of surface tension of sodium-potassium alloys by the bubble-pressure method is also included.

162 Thermal and Electrical Properties of Ductile Titanium by E S Greiner and W C Ellis Metals Technol 15 Tech Pub No.2466 (1948) Sept 9p

Many of the physical properties of ductile titanium metal of approximately 99.9% purity have been determined and are reported in this paper. The lattice constants of the close-packed hexagonal phase at 25°C are: $a = 2.945_0$, and $c = 4.684_5$ kX. The axial ratio, $c/a = 1.590_7$. The temperature of the transformation from close-packed hexagonal to body-centered cubic structure has been established by electrical measurements to be 885 ± 2°C. The mean linear coefficient of thermal expansion of titanium for the range 30-200°C is 9.0×10^{-6}°C^{-1}. The electrical resistivity at 20°C is 55 microhm-cm, which is very high for a pure metal. Associated with the high resistivity is a temperature coefficient which approximates the values for metals of high conductivity. This is explained by the theory which has been developed for conduction in transition elements. The thermoelectric power of titanium is small over the temperature range studied. Several tables and graphs are included.

163 X-Ray Investigation of Gold-Cadmium Alloys Rich in Gold by Anders Bystrom and Karl Erik Almin Acta Chem Scand 1 76-89 (1948)

The results obtained are presented in the form of an equilibrium diagram, and differences between this diagram and those presented by other authors are pointed out. Complete data are given for the various phases, and results of the powder photographs are listed in detail.

METALLURGY (continued)

164 Zirconium in Magnesium by H Altwicker AMC Intelligence Report F-TR-1185 (ATI No.27205) Aug 1948 19p

The results of research and development in magnesium-zirconium alloy systems, which were accomplished at the I.G. Farbenindustrie, are presented in this report. Owing to the relatively poor solubility of zirconium in magnesium, a number of difficulties were experienced in the initial stages. The two methods employed were: (1) use of metallic zirconium; and (2) introduction of zirconium containing salts into the melt. The results and statistics relative to grain refinement in the various compositions are given in the text, which is accompanied by tables and figures for castings, sheets, extrusions and welded specimens.

MINERALOGY

165 Radioactivity Exploration with Geiger Counters by Henry Faul Mining Technol 12 Tech Pub No.2460 (1948) Nov 18p

The radioactivity measurement of rocks and ores as a method of geophysical exploration is discussed in three categories: (1) surface radiation measurement, (2) radioactivity logging, (3) laboratory analysis. The use of small portable counters, made possible by advances in battery design, is reviewed and a cross section and a schematic drawing for these counters are given. It is pointed out that in cases where high gamma-counting efficiency is required, a scintillation counter may replace the Geiger-Müller counter.

NEUTRONS

166 Total Cross Sections of Small Samples of Hf, Er, Ni^{58}, and Ni^{60} from Neutron Crystal Spectrometer Measurements by S Bernstein, J B Dial, T E Stephenson, M M Shapiro and C P Stanford. AECD-2404 nd Decl Dec 8 1948 1p

This document is an abstract; it is reproduced below in its entirety.

A focussing type spectrometer using a variable curvature quartz crystal as originally described by L. Borst, et al, (Phys Rev 70 108 (1946)) has been developed further for measuring total cross sections versus energy of small samples of rare elements and separated isotopes. Samples having cross sections from 0.1 to 1.0 square millimeters have been used as absorbers. The main features of the new instrument are described. Test runs were made on normal cobalt, whose total cross section was found to fit the formula, σ (barns) = 5.8 + 6.17 (E in $ev^{-1/2}$), in fair agreement with earlier results. (C. S. Wu, et al, MDDC 480). A resonance at about 1 ev attributed in the literature to zirconium was found to belong to hafnium. Erbium was found to have a neutron resonance at about 0.5 ev Ni^{58} was found to be the isotope primarily responsible for the anomalously high scattering cross section of normal nickel, confirming the recent (unpublished) results from neutron diffraction studies of C. G. Shull et al at Oak Ridge National Laboratory. Results are given also for Ni^{60}.

167 Photodisintegration of Deuterium and Beryllium by the Gamma Rays of Na^{24} and Ga^{72} by A H Snell, E C Barker and R L Sternberg AECD-2406 nd Decl Dec 8 1948 1p

This document is an abstract; it is reproduced below in its entirety.

Samples of pile-activated Na and Ga were inserted in spheres of D_2O and Be, and the resulting photoneutron sources were placed in the center of a spherical air cavity in a large block of paraffin. The photoneutron outputs were measured with parabolic indium foils placed in the paraffin. (As a standard for comparison, S. Bernstein supplied a Ra-γ-Be source which had been compared, directly or indirectly, with other sources which had been absolutely calibrated in three independent measurement.) The Na and Ga sources were then dissolved, and their strengths were determined by beta counting of aliquots. Following a few corrections, simple theory leads to the derivation from these measurements of the quantities $\Sigma_i \alpha_i \sigma_i$, where α_i is the relative intensity (mean number of quanta

NEUTRONS (continued)

per disintegration) of the ith gamma ray above the photoneutron threshold, and σ_i is the associated photodisintegration cross section. The results are as follows:

Na-D_2O	14.5×10^{-28}	Ga-D_2O	2.84×10^{-28}
Na-Be	6.82×10^{-28}	Ga-Be	2.18×10^{-28}

For Na, $\alpha = 1$ and the figures give the cross sections in cm^2 for 2.76 Mev gamma rays. For Ga, the results will be compared with the published disintegration schemes of Haynes (Phys Rev 74 423 (1948)) and Mitchell, Saffarano and Kern (Phys Rev 73 1424 (1948)). In absolute precision, the figures are thought to be correct within 10 percent.

168 A Photographic Emulsion Method of Measuring Relative Fission Cross Sections by Maurice M Shapiro. AECD-2408 nd Decl Dec 8 1948 1p

This document is an abstract; it is reproduced below in its entirety.

A photographic-plate method of measuring neutron fission cross section, described by Borst and Floyd, (Phys Rev 70 107 (1946)) has been modified so as to obviate neutron flux measurements as well as corrections for detection efficiency. The sample under investigation is placed against an Eastman NTC photoplate sensitive to fission fragments but insensitive to alpha particles. A standard sample of known cross section is placed against another such plate. Then the two sample-photoplate pairs, in juxtaposition, are irradiated simultaneously in the same neutron flux. After development of the emulsions, fission-fragment tracks are counted microscopically over equivalent areas. The relative fission cross section is thus obtained. When the samples are both alpha emitters or both beta emitters of known half-lives, a relative determination of the quantity of each isotope suffices, thereby avoiding efficiency corrections in the assay. This method is especially applicable to rare substances, since only minute ($\approx$ microgram) quantities are required. Suitable modifications of this method lead to other applications, e.g. the assay of mixtures of isotopes and the identification of suspected isotopic contaminants.

169 Energy of Photoneutrons from Deuterium as a Function of Angle and Gamma-Ray Energy by Gertrude S Goldhaber. Brookhaven National Laboratory Report BNL-I-3 Aug 1948 5p

Polar coordinate graphs are given illustrating the dependence of photoneutron energy on angle.

170 The Angular Distribution of D-D Neutrons Scattered by Deuterons by J F Darby and J B Swan Australian J Sci Research 1A 18-27 (1948) Mar

The angular distribution of D-D neutrons scattered by deuterons has been investigated using a Wilson cloud chamber. The apparatus and experimental procedure and the method of selecting and reducing the observations are described. Comparison of the result with the calculations of Buckingham and Massey (Proc Roy Soc 179A 123 (1941)) indicates better agreement with the distribution to be expected, if ordinary, rather than exchange, forces are assumed. A curve is shown of the track lengths as a function of recoil angle and a number-range histogram is given. Curves of the intensity of scattering per unit solid angle as a function of angle of scattering for the two theoretical cases (assuming ordinary and exchange forces) are shown with the experimental data curve. Tabulated data are also given indicating the corrections used.

171 Delayed Neutrons from U^{235} After Short Irradiation by F de Hoffmann, B T Feld and P R Stein. Phys Rev 74 1330-1337 (1948) Nov 15 (See also AECD-1917)

This article is based upon AECD-1917. An abstract of the document appeared in Abstracts of Declassified Documents II 312 June 30 1948.

NEUTRONS (continued)

172 Depolarization of Neutrons During Diffusion by Sidney Borowitz and Morton Hamermesh Phys Rev 74 1285-1293 (1948) Nov 15

A theoretical analysis is given of the depolarization to be expected when a plane, monochromatic, polarized beam of thermal neutrons is incident normally on a slab of finite thickness in which the neutrons are scattered isotropically and without capture. The problem reduces to the solution of an integro-differential equation of the Wiener-Hopf type. The equation is solved approximately by a method of G. C. Wick (Z Physik 121 702 (1943)). Experimental possibilities for measuring the scattering amplitudes by this method, even in the case where neutron-nuclear forces are not very spin-dependent, are excellent. The case where the capture cross section is different from zero is also included.

173 Disintegration of Deuterium by Gamma-Rays from ^{24}Na by N O Lassen Phys Rev 74 1533-1534 (1948) Nov 15 (Letter to the editor)

The angular distribution of the photoprotons from the reaction $H^2(\gamma,n)H^1$ have been further investigated since previous results of several investigators are not in agreement and have been made chiefly in the 0°-90° range. Parallel proportional counters filled with deuterium were subjected to γ-radiation of about 500 millicuries at 30 cm. The pulse-size distribution curve obtained is shown for an angle of 90°. The angular distribution of photoprotons and neutrons obtained using Na^{24} as a γ-source is shown; the results are in good agreement with the theory (Graham and Halban, Jr., Revs Modern Physics 17 297 (1945)). Assuming a 1.5 cm range in deuterium, the total cross section is found to be 2.5×10^{-27} cm^2. This value is, however, only a rough approximation dependent on the accuracy of the determination of the absolute strength of the Na^{24} source and the proton range.

174 Disintegration of Nitrogen by Fast Neutrons by C P Sikkema Nature 162 698-699 (1948) Oct 30

The reactions N^{14} (np) C^{14} and N^{14} ($n\alpha$) B^{11} have been investigated using the monoenergetic neutrons, obtained by bombarding a thin heavy-ice target with deuterons. With a deuteron energy of 400 Kev and a variation of the angle between the direction of the neutrons used and the beam of impinging deuterons from 34° to 138°, the neutron energy was varied between 3.2 and 2.1 Mev. The number of (np) and ($n\alpha$) reactions was determined using a nitrogen-filled proportional counter placed in various positions. The number of neutrons per unit of solid angle in the direction of a boron fluoride counter for a given number of counts was determined. The cross-sections obtained are represented as a function of the neutron energy; a resonance for 2.23 Mev is indicated, corresponding to an excited state of the intermediate $_7N^{15}$ nucleus which is calculated to be 12.87 Mev above the ground state. Absorption measurements in the region of the maximum made with dicyandiamide ($C_2H_4N_4$) resulted in a value for the total cross-section of about 2×10^{-24} cm^2. The work of previous investigators is discussed, and it is concluded that the author's results are in agreement with previous experimental results and the values expected from the theory.

175 Gamma-Rays from the Reaction $H^1(n,\gamma)D^2$ and the Binding Energy of the Deuteron by R E Bell and L G Elliott Phys Rev 74 1552-1553 (1948) Nov 15 (Letter to the editor)

The gamma ray accompanying the capture of a neutron by a proton has been studied in a magnetic lens beta-ray spectrometer by means of photoelectric conversion in a thin uranium radiator. The momentum distribution of the secondary electrons ejected from a uranium radiator of 142 mg/cm^2 is shown. (This includes photoelectrons and Compton recoil electrons.) The counting rate taken with a spectrometer line width of 2.4 percent in momentum is plotted as a function of the focusing current in the lens coil (which is an accurate relative measure of the electron momentum). The gamma-ray energy deduced from the position of the photoelectron line is 2.236 0.005 Mev using the 2.62-Mev gamma ray of ThC" as the standard for the spectrometer calibration.

NEUTRONS (continued)

By adding the nuclear recoil energy to the gamma-ray energy, the binding energy of the deuteron was determined as 2.237 ± 0.005 Mev, which departs markedly from the previously accepted value (Stephens, Revs Modern Physics 19 19 (1947)). Taking the H^1H^1-D^2 separation as 1.433 ± 0.002 Mev, the neutron mass, using the new binding energy value, is determined to be 1.008992 ± 0.000010 amu. This gives a new value for the n-H^1 difference of 0.804 ± 0.009 Mev, resulting in a reduction by a factor of 1.3 in the theoretical lifetime of the neutron.

176 The Interaction of High Energy Neutrons and Heavy Nuclei by M L.Goldberger Phys Rev 74 1269-1277 (1948) Nov 15

The interaction of high energy neutrons with heavy nuclei is studied under the assumption that the nucleus may be described by the statistical model (Bethe and Bacher, Revs Modern Physics 8 83 (1936)). A detailed study is made of the energy transferred to the nucleus, the angular distribution of emerging particles, and the effective cross section for neutrons passing through nuclear matter. The theoretical angular distributions obtained show that the expected dip in intensity in the forward direction for scattering high energy neutrons from heavy nuclei occurs over a relatively small angular interval (approximately 25°) which should make experimental measurements difficult. The mean free path in nuclear matter for a neutron with energy 90 Mev outside the nucleus computed on the assumption of isotropic scattering in the center of mass system is 5.52×10^{-13} cm, whereas that computed using the observed angular dependence is 6.20×10^{-13} cm. The average excitation energy of nuclei bombarded with 86.6-Mev neutrons is 42.5 Mev.

177 The Neutrons Emitted in the Disintegration of Nitrogen by Deuterons by W M Gibson and D L Livesey Proc Phys Soc 60 523-532 (1948) June 1

The photographic plate method has been used in a study of the neutrons produced in the disintegration of nitrogen by deuterons. A single group of neutrons, corresponding to an energy release of (5.15 ± 0.10) Mev, was detected, but the existence of the low-energy neutron group reported by Stephens, Djanab and Bonner (Phys Rev 52 1079 (1937)) was not confirmed. The new results show that, if this group does exist, its intensity is not more than 15% of that of the principal neutron group, and that no excited levels of the 10^{15} nucleus less than 5 Mev above the ground state are effective in this reaction. The neutron flux from the N + D reaction was compared with that of D + D neutrons produced by disintegration of deuterium present in the surface layers of the target employed. The data obtained were used in determinations of the angular distributions of the D + D and N + D neutron fluxes, and in tests of the reliability of the photographic plate method for relative flux measurements. 18 references.

178 Space Energy Distribution of Neutrons in a Moderator of Infinite Size by Gunnar Holte Arkiv Mat Astron Fysik 35A No.2 1-12 (1948) (In English)

Taking into account a simple variation of mean free path with energy, a distribution function for neutrons in a moderator of infinite size is derived and compared with the experimental data of several investigators. The neutron density is proportional to $e^{-(r/r_0)^2}$, for sufficiently large values of E/E_0 and in the neighborhood of the source e, within a distance of r_0. When light atoms are present in the moderator, or for rapidly varying mean free path, or for high values of E_0, deviations from the Gaussian distribution appear earlier. Except for the aforementioned cases, the formula derived is applicable where the neutron density is negligible compared to that in the neighborhood of the source so long as r/r_0 is not too large.

NUCLEAR PHYSICS - METHODS OF MEASURING

179 Interval between Pulses of Counter or Scaler by Robert R Coveyou. AECD-2396 July 12 1945 Decl Dec 6 1948 3p For publication in NNES Document for sale by AEC

The problem of testing the statistical reliability of counters and scalers under the conditions that the number of counts remains fixed while the time is the statistical (stochastic) variable is

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

discussed. The particular case under consideration is the operation of a recording tape scaler which records pulses from a counter or scaler upon a tape as a function of time.

180 Testing of Counter-Scaler Units for "Statistics" by R R Coveyou. AECD-2397 Jan 1 1945 Decl Dec 6 1948 12p For publication in NNES

The results of an investigation of a test for statistical consistency of counter-scaler units may be summarized as follows: If m counts on the same sample are to be taken, then $\Sigma\ (X_i - \overline{X})^2 = \Sigma\ X_i$, approximately, and assuming the counter is in good order, X_1 = the result of the i^{th} count and $\overline{X}$ = the average of the m determinations. If we define $\Sigma\ (X_i - \overline{X})^2/\Sigma\ X_i$ as equal to K, and if the test be run on a basis of recorded scaler counts, then $K = Q\ \Sigma\ (Y_i - \overline{Y})^2/\Sigma\ Y_i$. Y_i = the result of the i^{th} count in scaler units, $\overline{Y}$ = the average of the Y_i and Q = scaling factor of the circuit between tube and recorder. Neglected counts may be shown to have little or no influence on the value of K. It may be easier, if a Friden calculation be available, to use the formula, $K = \Sigma\ X_i^{\ 2}/\Sigma\ X_i - \Sigma X_i/m$, with a similar formula analogous to the equation $K = Q\,\Sigma\,(Y_i - \overline{Y})^2\ /\Sigma\ Y_i$.

181 The Determination of Gamma-Ray Energies with the Magnetic Lens Spectrometer by E N Jensen. AECD-2399 (ISC-12) Dec 15 1947 Decl Dec 3 1948 78p Document for sale by AEC

An iron-free thin magnetic lens beta-ray spectrometer has been constructed. The spectrometer is mounted with its axis parallel to the earth's magnetic field. The vacuum chamber consists of an aluminum tube 100.9 cm long, 17.8 cm outside diameter and 0.32 cm wall thickness. The magnet coil has an inside radius of 9.9 cm, an outside radius of 28.3 cm and an axial length of 10 cm. The coil consists of 2799 turns of #12 single cotton enameled copper wire. The gamma-ray energies of Co^{60}, Zn^{65}, and Se^{75} have been determined, using the photoelectrons ejected from a thin lead foil. The internal conversion spectrum of Se^{75} has also been determined. A detailed study was made to determine the appropriate correction for the radiator thickness. The correction for the earth's magnetic field is made by correcting the observed value of the current required to focus electrons of a particular momentum. 23 references.

182 "Poppy" - Pulse Type Detector for Alphas, Betas, Gammas, and Neutrons by C J Borkowski and C R Marsh. AECD-2410 (CP-3316) June 30 1945 Decl Dec 7 1948 27p Document for sale by AEC

A pulse type survey instrument operating on 110 volts AC has been developed for the detection of alpha particles, beta particles, gamma rays, slow and fast neutrons. Both audible and visual indication of intensity is obtained.

183 Brookhaven Conference Report: High Speed Counters and Short Pulse Techniques. Brookhaven National Laboratory Report BNL-C-1 Aug 15 1947 51p

The following topics are discussed: crystal counters, fast Geiger counters, multipliers and secondary emission phenomena, Cerenkov counters, coincidence techniques, and broad band amplifiers.

184 Methods for Reducing Insulator Noise and Leakage by F M Glass. Oak Ridge National Laboratory Report ORNL-191 Nov 17 1948 20p

A study of the insulator problem involved in radiation detection instruments disclosed the fact that insulators, in high impedance input circuits, are the predominate source of background noise when subjected to high voltages and high humidities. Methods for eliminating this trouble in some of the commonly used circuit components, and new and superior insulating materials were found.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

185 Reduction of Microphonics in the Parallel Plate Alpha Chamber by Charles Hemler. Mound Laboratory Report MLM-150 July 20 1948 11p

A study was made of the feasibility of the reduction or total elimination of the susceptibility of the instrument, Model C3T 1B, to resonate with normal room noises. Tests indicate that, with a modified chamber, the instrument is not as susceptible to normal room noises. Detailed drawings are attached.

186 Tetrode Characteristics of Raytheon Tube CK571AX by T Cantwell and J Sandock. Carbide and Carbon Chemicals Corporation K-25 Plant Report K-290 (MIT Engineering Practice School) Aug 28 1948 36p

Tetrode characteristics for the Raytheon subminiature electrometer tube CK571AX were obtained. Satisfactory grid current characteristics were not obtained. The tetrode characteristics indicate that the circuit gains obtainable by tetrode operation of the tube exceed the triode-operated gains. For example, a gain of fifty may be obtained with 3.0 screen volts, 45 volts plate supply, and 22.5 megohms plate resistance, in the -1.25 to -1.00 grid volts region. Tetrode plate characteristics are plotted. The curves extend from zero plate voltage to rated 45 v. A number of constant grid voltage curves are plotted for screen voltages of 1.5, 3, 6, and 9 volts. Some grid current characteristics obtained are plotted.

187 Air Proportional Counters by J A Simpson Jr Rev Sci Instruments 19 733-743 (1948) Nov

This article is based on MDDC-1315. An abstract of this document has been listed in Abstracts of Declassified Documents I 721 (1947) Dec 20.

188 A Cell-Type Gamma-Counter by J R Beyster and M L Wiedenbeck Rev Sci Instruments 19 819-820 (1948) Nov

A multicellular gamma counter, consisting of 12 sections, which has an efficiency approximately ten times that of the usual gamma counter, is described. Tests indicated uniform sensitivity and also that not more than 10% of the discharges are delayed more than 0.5 microsecond. The low background rate (less than two counts per second) suggests that this counter might be applied to beta counting as well.

189 The Correction for Self-Weakening in β-Ray Measurements by E Broda, W E Grummitt, J Gueron, L Kowarski and W Wilkenson Proc Phys Soc 60 460-466 (1948) May 1

Experimental details are given for the determination of self-weakening of β-rays in thick samples. The self-weakening correction factor in the case of twelve radio elements is found over a considerable region to depend logarithmically on the mass-thickness of the sample. The self-weakening half-thicknesses, $\eta_{\frac{1}{2}}$, is as a rule 2.2 times larger than the external weakening correction factor of mass-thickness and the value of the ratio $\eta_{\frac{1}{2}}/\epsilon_{\frac{1}{2}}$ are derived in a simplified theoretical treatment. 8 references.

190 Counter Tube Chem and Eng News 26 3597 (1948) Nov 29

A new aluminum beta-gamma counter tube, replacing the thin-walled glass tubes and operating at 900 volts with a plateau length of not less than 200 volts, has been developed by Victoreen Instrument Company. Its minimum operating life is 10^8 counts.

191 Decay Times of Scintillations by George B Collins Phys Rev 74 1543-1544 (1948) Nov 15 (Letter to the editor)

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

Quantitative values for the decay times of the phenolic compounds used as phosphors in scintillation counters have been obtained as a basis for their use in high-speed counting circuits. The phosphors were investigated by attachment to the envelope of a selected 931-A photo-multiplier tube, the output of which was connected to the deflecting plates of a microoscillograph. Representative traces obtained for naphthalene, anthracene, and phenanthrene are shown. Semi-log plots of the deflection observed as a function of the time indicated that the pulse shape was consistent with the charging up of the output circuit by a current $I = I_0 e^{-t/\tau}$, where τ is the time constant of the phosphor. On the basis of these plots, τ was determined for naphthalene, anthracene, and phenanthrene as (5.7 ± 0.5), (1.3 ± 0.2), and $(0.9 \pm 0.2) \times 10^{-8}$ sec, respectively. The results obtained indicate that a 1-Mev electron produces enough light in any phosphor to produce about 10 electrons from the cathode of a photo-multiplier tube and the build-up of this emission is of the order of 10^{-9} sec.

192 The Design and Construction of a Double-Focusing Beta-Ray Spectrometer by Franz N D Kurie, J S Osoba and Lewis Slack Rev Sci Instruments 19 771-776 (1948) Nov

For the measurement of beta- and gamma-ray energies a magnetic spectrometer of high resolution and large solid angles is necessary. One of the simplest instruments satisfying these specifications is the double-focusing beta-ray spectrometer. The design and construction of such an instrument having a mean radius of curvature for the electrons of 24.33 cm is described. Preliminary measurements show a resolution of about 1/3% and that about 0.2% of all the electrons of given energy which leave the source are focused on the counter. A photograph and diagrams of the instrument are shown.

193 Determination of the Most Probable Value of Statistical Magnitudes. Part II. Mean Life of Radioactive Elements by Georges Allard J Phys et Radium 8 262-269 (1947) Sept (In French)

The general results obtained previously (J Phys et Radium 8 212-214 (1947)) on the determination of the most probable value of statistical magnitudes and the precision of the value are applied to the determination of the mean lives of radioactive elements by means of counter experiments. The case of substances of short mean life is investigated both neglecting characteristic counter fluctuations and taking such fluctuations into account. The case for substances of longer mean life is treated also. Mathematical expressions for the two cases are developed along with the calculations of the errors involved in each case.

194 Discrepancies Caused by Source Charging in Beta-Spectrometers by C H Braden, G E Owen, J Townsend, C S Cook and F B Shull Phys Rev 74 1539-1540 (1948) Nov 15 (Letter to the editor)

Investigations have been made which indicate that numerous recent studies of β-spectra and internal conversion lines which have been performed with sources which were supported on non-conducting backing-foils (Zapon, nylon, cellophane, etc.) probably have errors in the energy measurements and β-spectrum shapes observed due to a source-charging effect. For a Zapon-mounted sodium source, the electrical insulation of the source from the body of the spectrometer acts as a small capacitance providing a high resistance leakage path between source and instrument. The excess of positron emission develops a negative charge on the source, resulting in a considerable potential difference between source and vacuum chamber. The effect of this is to decelerate positrons and to accelerate negatrons. The charging of an insulated β-source as a function of time, which is shown, has the roughly exponential form which would be expected.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

195 Efficiency of Counting Systems by M Blackman and J L Michiels Proc Phys Soc 60 549-561 (1948) June 1

A review is made of the derivation of formulae for the efficiency of counting systems, comprising in the general case a counter and amplifier, a scaling circuit and a recorder. In the case of recorders of constant resolving time no complete formula has been found in the literature, and this has been derived. A number of existing formulae are shown to be valid only for a particular type of variable recorder. A discussion is given of the use of the formulae in practical counter experiments. 10 references.

196 The Geiger Discharge by D H Wilkinson Phys Rev 74 1417-1429 (1948) Nov 15

It is pointed out that the phenomena concerned with Geiger counter operation which are well understood are those associated with the motion of the positive ion sheath, while those awaiting explanation are associated with the development of the discharge. A theory of this development is presented and used to calculate the following phenomena: (a) the relation between starting potential and counter variables, (b) the amount of charge generated in the discharge, (c) the shape of the plateau curve, and (d) the velocity of propagation of the discharge down the wire. Good agreement is obtained at all points. The curve relating the charge generated to the overvoltage consists of two parts, each a straight line; the slopes have a ratio of 2:1. The plateau curve is shown to climb more steeply to its constant value the greater the number of electrons liberated in the counter by the ionizing particle, and the effect is confirmed experimentally. The velocity of propagation is shown to exhibit a roughly linear variation with overvoltage, tending to a finite value at zero overvoltage. All forms of counter behavior are shown to depend strongly on the ratio of charge generated in the counter to that originally on the wire.

197 High Energy Neutron Detector by Clyde Wiegand Rev Sci Instruments 19 790-792 (1948) Nov

A neutron detector suitable for monitoring a flux of neutrons of energy greater than 50 Mev is described. Detection is accomplished by utilizing the fission produced in bismuth-coated plates of 1/32 in aluminum in a condenser-like arrangement. The chamber contains a mixture of 96% argon and 4% carbon dioxide at atmospheric pressure. A schematic diagram and curves of the counting rate as a function of discriminator bias and as a function of collection voltage are shown. The efficiency obtained is low (about 10^{-6}), but the instrument is suitable for monitoring a high energy neutron beam and for making beam attenuation measurements.

198 High-Voltage Supplies for G-M Counters by Alexander Thomas Electronics 21 No.12 100-103 (1948) Dec

Several types of high-voltage supplies for Geiger-Muller counters are described; their adaptibility to balloon flights and field service work is discussed. A tabular comparison of the limitations of several power supply types is given along with curves showing typical operation under normal conditions.

199 Linear Time Base Using OA4G Tube by B M Banerjee Rev Sci Instruments 19 821-822 (1948) Nov

A linear time base which utilizes an OA4G cold cathode control tube in place of the usual thyratron (884 or 885) is described. Elimination of the thyratron also removes the associated transformer. A diagram of the circuit and a photograph of the wave form of the voltage generated are shown. It is noted that the system is not suitable for repetition frequencies greater than 1000 c.p.s. The possible usefulness of such a device in a nuclear physics laboratory for visual monitoring of counter pulses in a cathode-ray tube is suggested.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

200 A Low Efficiency Counter by G Martelli and M Santangelo Nuovo Cimento 5 374-383 (1948) Aug (In Italian)

A method of preparing low-efficiency hydrogen counters is described, and the possibility of using them in cosmic ray experiments is discussed. Experimental values of the efficiency have been determined as a function of the pressure. These values are in good agreement with those calculated by the expression $k = 1 - e^{-jlp/p_o}$. The hypothesis that the formation of only one pair of ions is sufficient to excite the counter is accepted. On the basis of the above equation the authors found that for primary ionization at N.T.P. in hydrogen at sea-level the value 5.3 pairs of ions/cm was in good agreement with values found by other authors. The middle value of the path of the particles in the counter was calculated approximately by numerical integration. Such counters, when filled at low-pressure, are selective in respect to the primary ionization of the particles travelling through them. Cosmic ray particles of only slightly different ionizing powers may be distinguished by a set of such counters in coincidence arrangement. 7 references.

201 Measurement of Radioactive Phosphorus by N S Hall and A J MacKenzie In Symposium on the Use of Radioactive Isotopes in Soil and Fertilizer Investigations p101-106 Geneva, New York, Soil Science Society June 1 1948

The use of radioactive phosphorus in connection with phosphate studies requires that special attention be given to the measurement of the radioisotope. In summarizing this discussion the following considerations are presented: The G-M counter systems lend themselves more favorably to routine analytical work than do the electroscopes. However, the cost and rather strict requirements for routine operation may limit their usage. It is recommended that an electroscope be included for the purpose of monitoring for safe working conditions. The counting characteristics of the counter tube must be accurately known and frequently checked. The geometry of the sample with relation to the counter, and within itself, must be exact in reproduceability. Considerable adsorption occurs on the glassware and is of utmost concern when attempting to extend the limits of the use of P^{32}. The use of dimethyldichlorsilane is recommended for all measuring and manipulating equipment and butyl methacrylate for the treatment vessels. Contact with the stoppers should be avoided. In preparing the sample, it has been found most practical to filter the P as the $MgNH_4PO_4.6H_2O$ directly on a suitable holder so that the P^{32} and total P may be measured on the identical preparation. This provides for a more adequate estimate of the specific activity $[P^{32}/(P^{31} P^{32})]$. The preparation and maintenance of permanent standards, is essential in a radioisotope laboratory. The standards are used to check the counting equipment and make possible the comparison of data collected by different counting systems and at different periods. The statistics involved in counting are complicated by the fact that emission of the beta particle from the radioisotope follows a Poisson distribution. Calculations are based on the total number of counts made which is considered to be the mean of the population. 11 references.

202 Measurement of Radiocarbon as CO_2 in Geiger-Muller Counters by Maxwell Leigh Eidinoff Science 108 535-536 (1948) Nov 12

The author presents results of experiments on the gas counting of radioactive carbon dioxide as a quantitative procedure in the range 2-12 cm Hg pressure. This research was carried out with regular routine equipment, using threshold voltages ranging from 1450 to 2200 v, and the counting efficiency for beta particles emitted by carbon 14 was found to be close to 100%. A plot is given of the corrected counts per minute as a function of the partial pressure of a reference radioactive CO_2 sample. This gives a straight line, with a slope of 918 counts/min, cm Hg, the average deviation of the experimental points from the straight line being 1.1%. Threshold voltages at different partial pressures are also presented.

203 Milli-microsecond Pulse Generation by Electron Bunching by J B Hasted Proc Phys Soc 60 397 (1948) April 1

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

Work is in progress on a project for coincidence counting of nuclear particles with a resolution of the order of 10^{-9} seconds. Equipment has been built for the production of milli-microsecond pulses by bunching electrons with alternating voltages of frequency 210 Me/s, on the assumption that the mathematical theory of electron bunching applies. A diagram of the bunching pulse generator and associated circuits is given. From the power observed in the 14th harmonic, and the agreement with theory, it is expected that this device will be capable of supplying pulses of variable width and of duration short enough for testing wide-band coincidence counting circuits. 3 references.

204 Observations of Naphthalene Scintillations Caused by Tritium Beta-Rays by R F Taschek and H T Gittings Phys Rev 74 1553-1554 (1948) Nov 15 (Letter to the editor)

Some preliminary observations on the scintillations produced in commercial naphthalene by tritium beta rays and bremsstrahlung coming from tritium occluded in tantalum are described. If a maximum beta energy of 15 Mev is assumed for tritium, then pulses down to 10 Kev beta energy are being observed, according to the data obtained using a 1P21 photomultiplier tube. A conservatively estimated value of 6 percent for the lower limit on the conversion efficiency was obtained. Future work using anthracene is planned.

205 On the Interpretation of Radioactive Thorium Stars in a Photographic Emulsion by Richard Westoo Arkiv Mat Astron Fysik 34 B No.22 (1948) 8p

The paths of α-particles are registered in a photographic emulsion after soaking in a solution of thorium nitrate. Successive radioactive disintegrations give rise to tracks starting from a common point and thus forming a "star" in the emulsion. A number of tracks have been measured for different kinds of solvent, i.e., water, dilute hydrochloric acid and alcohol. The diffusion of the solution into the photographic layer is quite different in these three cases, but the types of stars obtained agree well with those expected from the transformation series of thorium. The mean ranges are calculated and compared with previous values.

206 On the Statistical Treatment of Counter Data by Njål Hole Arkiv Mat Astron Fysik 34B No.20 (1948) 8p

In the first section is discussed quite generally the physical assumptions which are usually made when the loss in a counter is treated mathematically. The simplifying assumptions which are made in such calculations are also discussed. In the second section a survey of the usual correction formulae together with a discussion of various mathematical methods applied in this field is given. The reasons why different authors obtain different results are discussed. In section three, a treatment of the theory of a scale of x is made. It is shown that previous calculations on this problem are not quite correct.

207 On the Technique of Constructing an All Metal Geiger-Muller Counter, by R Berardo, L Mezzetti and E Pancini Nuovo Cimento 5 370-373 (1948) Aug (In Italian)

A new model of an all-metal Geiger-Müller counter is described. The simple construction makes mass production possible even with very limited machinery. Diagrams are included.

208 Optical Method of Determining Thickness of Geiger Tube Windows by F W Brown, III and A B Willoughby Rev Sci Instruments 19 820-821 (1948) Nov

An interference technique, which may be used on assembled tubes, for determining the thickness of mica for thin window counters is described. The method is an adaptation of the general procedure for determining thin film thickness as outlined in Wood's "Physical Optics." A photograph of the interference fringes of 1.56 gm/cm^2 mica together with the comparison spectrum is shown. A curve of the weight of mica in mg/cm^2 as a function of the number of interference fringes observed is also shown, and a formula expressing the relationship is given. Experimental points are found to lie on the calculated curve.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

209 The Photo-Multiplier Radiation Detector by Fitz-Hugh Marshall, J W Coltman and A I Bennett Rev Sci Instruments 19 744-770 (1948) Nov

The photo-multiplier radiation detector, which is discussed in detail, consists of a commercial multiplier photo-tube arranged to register the scintillations produced in a fluorescent screen by radiation quanta. The signal pulses thus obtained are large for alpha particles and other high velocity ions, much weaker for x-rays, gamma rays, and high velocity electrons. The method is limited by the presence of noise pulses caused by electrons thermally emitted at the photo-cathode; signal pulses can be discriminated from noise pulses only to the extent that their amplitudes are greater. Satisfactory detection of the weaker signal pulses has been accomplished by careful attention to (1) selection of photo-tubes, (2) choice of fluorescent screen, (3) efficient collection of light, and (4) proper circuit design. The new detector is especially suited to narrow-beam measurements where high counting rates are desired. However, it compares favorably with conventional detectors even when low counting rates and weak signal pulses are involved. The detector is rugged and fast, requires no special thin-window technique, and shows high efficiency. The primary detecting medium, being a solid, has high absorption and is well defined in position. Full construction details, an analysis of performance characteristics, and numerous suggestions for further improvement are included. 20 figures.

210 A Photoelectric Trigger by F R Marshall and A M Zarem Rev Sci Instruments 19 816 (1948) Nov

A photoelectric trigger circuit employing a thyratron and a multiplier photo-tube is described and a diagram is shown. The positive output signal is obtained directly from the multiplier photo-tube by placing the load in the last dynode lead of the tube, the remainder of the circuit being essentially conventional. The limitations of the circuit, as compared with the usual anode connection are that the dynode current is slightly lower than the anode current and that slightly more non-linearity is introduced by this connection, since the dynode resistance is not as high as the anode resistance. Both of these can be reduced to negligible values, however.

211 The Photographic Method in Nuclear-Physics Experiments by M Bogaardt Nederland Tijdschr Natuurk 14 93-113 (1948)

The author reviews the latest methods and work done using photographic means on mesons, cosmic rays, and nuclear fission. 30 references.

212 Production of Large Crystals of Naphthalene and Anthracene by Charles E Feazel and C Dixon Smith Rev Sci Instruments 19 817-818 (1948) Nov

The method of Hendricks and Jefferson (J Optical Soc Amer 23 299 (1933)) has been used to produce large crystals of anthracene and napthalene. A molten tube of the material to be crystallized was slowly lowered from an electric combustion furnace under suitable conditions. By this method a single napthalene crystal of 2-cm diameter and 5-cm in length was produced. Several anthracene crystals about 1x1x2.5 cm were also obtained in this manner. Such crystals are used in connection with scintillation counter investigations.

213 Proportional Counter Chem Ind 63 832 (1948) Nov

A counter designed to count α-particles in the presence of strong β-activity is described. The Model 117 developed at Instrument Development Labs (now named Nuclear Instrument & Chemical Corporation, Chicago) has the following features: 1) a methane flow proportional flow counter with sample holder, 2) a built-in variable high gain linear amplifier, 3) a scaling circuit with eight stages giving a ratio of 256:1, 4) built-in high speed impulse recorder, 5) variable high voltage supply.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

214 Proposed Method for Measuring Scattering of Particle Tracks by S A Goudsmit and W T Scott Phys Rev 74 1537-1538 (1948) Nov 15 (Letter to the editor)

A simpler method for the measurement of the scattering of particle tracks than that which is commonly used (Lattimore Nature 161 518 (1948)) is suggested. Using the expression obtained for the case of Ilford plate observations, values for $(L-d)_{av}$ of 3.9, 5.6, and 1.2 microns are obtained for the last 200 microns of the tracks of a π-meson, a μ-meson, and a proton, respectively. In making these measurements, L is the actual track length under consideration and d is a straight line appropriately drawn relative to L so that (L-d) is a measure of the scattering. The inaccuracy of this method, which is admittedly large, is justified on the grounds that in any such scattering measurements high precision is out of place.

215 Radiation Survey Meter Chem and Eng News 26 3597 (1948) Nov 29

A small, portable, Geiger-Müller-type survey meter, equipped with a light-weight, weatherproof probe and cable assembly and capable of detecting both beta and gamma rays, has been developed by Precision Radiation Instruments, Inc.

216 Relation between Apparent Shapes of Monoenergetic Conversion Lines and of Continuous β-Spectra in a Magnetic Spectrometer by G E Owen and H Primakoff Phys Rev 74 1406-1412 (1948) Nov 15

A method has been developed for correcting distortions which affect the apparent shape of a continuous β-ray spectrum. Internal conversion lines are studied in the β-spectrometer and found to have a finite width and in the case of 180° focusing an unsymmetrical shape. On the assumption that these conversion lines are actually monoenergetic, it is possible to calculate the distortion produced by the spectrometer and source, and thus to determine the approximate true shape of the continuous β-ray spectrum from the experimental data. The Kurie plots for a continuous β-ray spectrum corrected in this way are, in general, straight over a greater range than the plots of the uncorrected data. The correction has been applied to the ratio of the number of positrons to the number of electrons in Cu^{64}, giving better agreement with the Fermi theory.

217 A Scale of 64 Circuit by P Bassi and A Loria Nuovo Cimento 5 367-369 (1948) Aug (In Italian)

A scale-of-64 circuit, consisting of six scales of two units is described. No vacuum-tube coupling is used. The resolving power of the first unit is 6×10^{-6} seconds. The losses of the whole circuit are about 1% in counting 25,000 pulses per second occurring at random. 3 references.

218 Simple Quenching Circuit for G. M. Counters by J Wesolowski and B Makiej Acta Phys Polon 9 No.1 59-60 (1947)

A variation of Yetter's circuit (Phys Rev 53 612 (1948)) is described. The cylinder of the counter is at a fixed potential (zero if required) and the recovery time $\simeq 3 \times 10^{-4}$ sec.

219 A Simple Recording System for Small Currents by G W Monk Rev Sci Instruments 19 821 (1948) Nov

A simple system for recording small ion currents is described which is perfectly reliable where a slight zero drift in a few hours is not important. It is especially suitable for recording receiver current in mass spectrometers and has been used in this connection. A circuit diagram of the recorder for use with the "Electronik" strip-recording potentiometer is shown.

220 A Simple Spectrometer-Counter for Radioactive Isotope Measurements by L L Woodward and D A McCown Rev Sci Instruments 19 823-824 (1948) Nov

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

A simple spectrometer counter for the separation of negative and positive beta activities into measurable components is described. An electromagnet is used to produce a field which will deflect the beta radiation from the sample between its pole faces. The counter is arranged to intercept radiation after deflection through 180°. Activity and counting rates for samples thus studied are given. This device has made possible the identification of radioactive isotopes which could not be obtained by the resolution of composite decay curves, either because their half-lives were nearly the same as those of other activities present, or because their activities were small compared with other activities present. In addition to isotope identification the application of this method to the determination of approximate end-point values is discussed.

221 Support for Geiger-Mueller Counters by Ernest H Wakefield. U. S. Patent 2,443,365 Dec 11 1945 Assigned to Atomic Energy Commission

A diagram of the apparatus is given and consists of, in combination, a Geiger-Mueller counter tube, an elongated radiation shield openable at one end, an elongated rigid support mounted in the other end of the shield and extending lengthwise in the shield cavity, a clamp slidable along the support, a counter tube rigidly secured to the clamp, an external insulated conductor extending into the shield cavity and connected to a conductor of the tube, means on the clamp securing one end of the external conductor in a fixed position relative to the tube, and a handle of electrically insulating material on the clamp and extending toward the openable end of the shield, whereby the tube may be moved along the support and remain free of tension on its conducting leads.

222 Theory of Dark-Trace Tubes Part I by F Seitz. National Defense Research Committee Division 14 Report No.131 (Carnegie Institute of Technology) Apr 23 1943 37p

A brief survey of the experimental information dealing with the processes in dark-trace tube (DT) screens is given. It is assumed that the deposits in the DT screens are in a state of disorder that is high compared with that normally found in crystals of the alkali halides at room temperature. It is suggested that the number of alkali-ion vacancies and the halogen-ion vacancies is of the order of one percent of the total number of lattice sites. Transport data for the vacancies present in the lattice are determined from available information on the ionic conductivity of the alkali halides. It is concluded that the high density of vacancies proposed is metastable at room temperature. In fact, a trend toward equilibrium should be observed only in the neighborhood of 400°C. It is concluded that appreciable clustering of pairs of vacancies of opposite sign probably takes place at room temperature. It is suggested that the two absorption bands observed in the visible part of the spectrum, which have previously been called the F-band and the R-band, are to be associated with electrons that are, respectively, trapped in isolated halogen-ion vacancies and in paired halogen-ion vacancies. The first type of absorption center is simply the F-center, whereas the second is analogous either to an H_2^+ molecular ion or to a neutral H_2 molecule depending upon whether the paired vacancy has captured one or two electrons. It is shown that both of these molecular-like centers can reasonably have the properties possessed by the centers responsible for the R-band. It is suggested that the absorption bands associated with the holes trapped at vacant alkali-ion sites lie in the ultraviolet part of the spectrum. It is suggested that the vacancies lose most of their mobility when they have captured electrons or holes. It is proposed that the assistance rendered by a weak electron beam in washing out the trace in the presence of light arises from the fact that electron excitation converts R-centers into F-centers more effectively than light alone can. It is pointed out that a weak electron beam would not wash out the trace in the absence of light if the intrinsic darkening and reversal processes depended linearly on the intensity of the beam.

223 The Theory of Dark-Trace Tubes Part II by F Seitz. National Defense Research Committee Division 14 Report No.172 (Carnegie Institute of Technology) Sept 1 1943 41p

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

A new mechanism for the darkening process in DT screens is proposed. The mechanism is based on an interpretation of three types of experiments, namely (a) experiments concerning shifts in the absorption bands that occur when crystals containing F-centers are irradiated with visible light; (b) experiments carried out on photoconductivity in colored alkali-halide crystals; and (c) experiments on DT tubes carried out at various laboratories under the sponsorship of the Radiation Laboratory. It is suggested that the color arises from F-centers. which are negative-ion vacancies occupied by electrons. However, it is not assumed that the vacancies are present initially in an atomically dispersed form. It is suggested that they are either aggregated into clusters which dissolve under the action of the electron beam, or that they are generated at the surface of the crystal during bombardment. The solution of aggregates and the generation of vacancies at the surface is possible only because positive-ion vacancies and pairs are mobile at room temperature. It is suggested that the darkening attainable with a given electron current reaches an equilibrium value that depends on the current because the reaction responsible for the production of isolated vacancies proceeds in both forward and backward directions during bombardment. The density of reaction product responsible for darkening, namely the negative-ion vacancies, is increased by increasing the electron current density because the equilibrium point of the reaction is displaced, as if the law of mass action applied. A tentative mechanism is suggested for the process of agglomeration of F-centers in colored screens and crystals which occurs when they are exposed to light.

224 The Theory of Dark Trace Tubes Part III by F Seitz. National Defense Research Committee Division 14 Report No.257 (Carnegie Institute of Technology) Apr 6 1944 27p

The purpose of the report is to summarize briefly views regarding the theory of dark trace screens. Two sections summarize the properties of pure KCl screens. Another section contains a summary of the properties of doped screens. It is pointed out that present knowledge concerning doped screens is still in a very unsatisfactory stage.

225 Thimble-Chamber Calibration on Soft X-Rays by Frank H Day. J Research Natl Bur Standards 41 295-300 (1948) Oct

Condenser r-meter (Victoreen-type) thimble chambers of various types have been calibrated against a standard free-air ionization chamber to indicate the wavelength dependence of their readings after exposure to x-rays excited by potentials ranging from 10 to 200 kv. Such chambers are customarily calibrated with x-ray beams produced by tubes having an applied voltage of 70 to 200 kv. The study was undertaken to determine the error introduced when measurements on softer radiations are made using chambers of this type. X-ray tubes with low inherent filtration were used and calibrations were conducted for minimum-filter conditions; the effect of added filtration on the calibration was noted. It has been observed, for instance, that a chamber that reads correctly for filtered radiation of 100-kilovolt quality is in error by a factor of 2.3 for 10-kilovolt x-rays. Curves of the ratio of the standard chamber reading to the r-meter reading as a function of the constant potential applied to the x-ray tube are shown for the various types of thimble chambers investigated.

226 Tiny Atom-Smasher Detects and Counts Neutrons Chem and Eng News 26 3510 (1948) Nov 22

A neutron counter has recently been developed at the Westinghouse Research Laboratories. In the counter a photoelectronic tube coated with a U^{235} and phosphor mixture will emit light when struck by a neutron which has been slowed down by a paraffin wall which lines the counter. The light thus emitted strikes a photosensitive screen and the electrons produced are multiplied and are used either to produce scintillations on a fluorescent screen or to transmit the electric impulses to a recording circuit.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

227 Two Automatic Methods for Measuring Condenser Chambers by Rolf M Sievert Acta Radiol 28 784-789 (1947)

Two new methods, automatic and semi-automatic, have been devised for making rapid measurements of large series of chambers of the same type. The semi-automatic method is used principally for roentgen doses in the region of 50-500 r and is operated from a keyboard with four buttons, by means of which the charge remaining after irradiation or, if desired, the loss of charge may be found. The device has an electric motor which elevates the contact pin in the electrometer towards the inner electrode of the chamber, while an electromagnetic arrangement connects the measuring electrode to either ground or charging source. The automatic device was developed for relatively large and heavy condenser chambers; this instrument includes a photographic registering cassette and a movable table which may be automatically raised and lowered by means of a motor. A measuring speed of at least 3-4 chambers per minute can be achieved with these devices. Close up pictures of the instruments are given.

NUCLEAR PROPERTIES

228 The Properties of Atomic Nuclei. Part I. Spins, Magnetic Moments, and Electrical Quadrupole Moments by J H Goldsmith and D R Inglis. Brookhaven National Laboratory Information and Publications Division Report BNL-I-5 Oct 1 1948 7p

Spin, magnetic moment and quadrupole moment are tabulated for atomic nuclei.

229 A Direct Determination of the Energy of the He^3 Nucleus from the D-D Reaction by Harold V Argo Phys Rev 74 1293-1299 (1948) Nov 15

The energy of the He^3 nuclei emitted at an angle of 90° with the incident deuteron beam in the D-D reaction has been measured directly by deflecting them through a 90°, 15-cm radius, cylindrical electrostatic analyzer. The He^3 ions were detected by allowing them to eject secondary electrons from the first plate of a 12-element electron multiplier tube. Thus the ions were not required to traverse any foil or window material between the heavy ice target and the point of their detection. The corrections to be applied to the electrostatic analyzer were experimentally investigated and when applied to the kinetic energies deduced from the observed critical deflecting voltages, give a Q value of 3.30 ± 0.01 Mev for this reaction.

230 The Eigenfunctions for the Bound State of the Deuteron in a Non-Symmetrical Theory by Carl Erik Fröberg Arkiv Mat Astron Fysik 35A No.17 1-7 (1948)

The author calculates the eigenfunctions of the ground state ($^3S + {}^3D$) of the deuteron and the corresponding quadrupole moment starting from the non-symmetrical scalar-pseudoscaler theory (neutral scalar and charged pseudoscalar mesons) with varying assumptions about the spin coupling constant. The calculations indicate that the quadrupole moment "Q" is proportional to "f^2" for small values of the spin coupling constant "f". In addition, it is necessary to assume a comparatively large value for f^2 to obtain the right size for Q. This contradicts Hulthen's supposition (Revs Modern Physics 17 263 (1945)) that Q is insensitive to variations in f.

Starting with the static interaction between two nucleons, a system of equations for the radial parts of the eigenfunctions is obtained. Values for the various constants from cosmic-ray experiments and proton-proton scattering data are substituted in the expressions, and the method of numerical integration of Runge-Kutta is used to calculate the eigenfunctions after the application of boundary conditions and the use of a power expansion and a particular transformation. After normalization of the functions, formulas for the quadrupole moment Q and the magnetic moment, μ_D, of the deuteron are obtained. Tabulated data are given for Q and μ_D as functions of the interval division b' used in the numerical integration. It is seen that f must be large to get the right value for Q. Then a reasonable agreement for $\Delta\mu$ and μ_D is also obtained.

NUCLEAR PROPERTIES (continued)

231 Further Remarks on the Magnetic Moments of H^3 and He^3 by R Avery and R G Sachs Phys Rev 74 1320-1322 (1948) Nov 15

Arguments for the existence of exchange moments in the H^3 and He^3 nuclei depend on an accurate evaluation of the spin and orbital contributions to the moments. Assumptions made in previous evaluations are re-examined. Although the results do not establish the existence of the exchange moment conclusively, arguments are presented which make the alternative appear to be less reasonable. Methods for obtaining further information on this question are discussed.

232 The Hyperfine Structure and Quadrupole Moment of Al^{27} by Hin Lew Phys Rev 74 1550-1551 (1948) Nov 15 (Letter to the editor)

The hyperfine structure of the metastable state of aluminum has been measured by an atomic beam method of radiofrequency spectroscopy similar to that employed by Zacharias (Phys Rev 61 270 (1942)). From the observed hyperfine separations the quadrupole moment of the nucleus has been determined, using the method of Davis, Feld, Zabel, and Zacharias (Phys Rev 73 525 (1948)) to be $+(0.156 \pm 0.003)\ 10^{-24}\ cm^2$.

NUCLEAR TRANSFORMATION

233 Photo-Induced Reations at 20 Mev by Dana L Mock, Ramond C Waddel, Lawrence W Fagg and Ralph A Tobin Phys Rev 74 1536 (1948) Nov 15 (Letter to the editor)

The probable reactions and the half-lives of the activities resulting when various elements were irradiated with x-rays from a 20-Mev betatron using a platinum target are tabulated. Isotopes of the following elements were investigated: As, Cb, Hg, I, Sn, Ru, Ba, Ag, Pd, Rh, Cd, Pt, and Bi. A relatively large cross section appears to be indicated for Rh. The only (γ,p) reaction observed was for Ru^{102}. However, such reactions may have been masked by the more prolific (γ,n) reactions observed, since the latter have a larger cross section as no Coulomb barrier is involved in removing a neutron. Calculated nuclear binding energies predict that either a proton or neutron should be removed by a 20-Mev photon bombardment of any nucleus. Except for Bi, all of the elements studied showed measurable activity, although in a few cases the data are incomplete.

234 Preparation of Pure Iron-59 of High Specific Activity by A W Kenny and W R E Maton Nature 162 567-568 (1948) Oct 9

Hydroferrocyanic acid was irradiated in the Harwell low-energy pile, and Fe^{59} obtained by extraction with dry, dilute ethereal hydrochloric acid in a Soxhlet apparatus. After irradiation for a month (slow neutron flux $2.5 \times 10^{10}\ cm^2/sec$) the activity was determined before and after extraction. It was seen that 50% of the total activity remained. The other 50% was accounted for in the ethereal extract, so that no loss of activity occurred. No more activity was extracted after the first two and a half hours. The extract was taken to dryness, and the residue digested with water. The aqueous extract contained at least 90% of the activity extracted by the ether and was pure Fe^{59}. The specific activity for this isotope was found to be 1.5 mc/gm.

PARTICLE ACCELERATORS

235 Particle Accelerators; Bibliography and List of High Energy Installations by E Thomas, P Mittelman and H H Goldsmith. Brookhaven National Laboratory Report BNL-L-101 July 1 1948 59p

The bibliography is divided into the following sections: general, betatron, cyclotron, electrostatic accelerator, proton synchrotron, synchrotron, ion sources and miscellaneous. A list of high energy installations inside and outside the United States is also given.

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236 Accelerating Atomic Particles by W M Brobeck Phys Today 1 No.6 27-30 (1948) Oct

The historic development of accelerators of atomic particles is discussed. Descriptions and diagrams of the various types of accelerators are shown.

237 Cyclotron Investigation Heidelberg, Germany by C W Hansell, J J Slattery, and J M Sanabria. Combined Intelligence Objectives Sub-Committee June 1 1945 24p (NP-458)

The cyclotron appeared to have no outstanding characteristics to distinguish it from those most commonly used in the United States. The steel magnet had been supplied by Krupp and the water cooled magnet coils by Siemens. There were ceramic insulator seals for the drive circuit, placed close to the D's. The drive circuit was of two 4-inch diameter copper tubes, provided with a short circuiting slider for tuning and introducing the drive power. The magnetic field current was supplied by a generator on flexible mountings and required 53 KW. Two Apiezon oil diffusion pumps and a mechanical pump in series provided the vacuum. There were Pirani and ionization vacuum gages, and as usual, there had been great difficulty with vacuum leaks, particularly because the vacuum chamber was made of cast material. There were no clever tricks for finding leaks. The usual method seemed to be that of putting the system under pressure and looking for leaks with soapy water. The cyclotron was said to be capable of producing particles with 9,000,000 volts energy. A water barrier of approximately four feet thick proved inadequate and it was necessary to construct a control panel at another point some 75 feet away.

238 Electromagnetic Radiation in Accelerators by V M Lopukhin and V A Ugarov Uspekhi Fiz Nauk 34 398-414 (1948) Mar (In Russian)

This is a statement of the theoretical principles underlying the phenomenon of the "luminous electron" discovered by Elder, Gurewitsch, Langmuir, and Pollock (Phys Rev 71 829 (1947)). The different types of accelerators, viewed as sources of this radiation, are discussed, with references to the contributions of Soviet physicists in the prediction of the new phenomenon and in the invention of the accelerators. Thus, Ivanenko and Pomeranchuk (Doklady Akad Nauk S.S.S.R. 44 315 (1944);) Phys Rev 65 343 (1944)) predicted in 1944 the radiation from rapid particles in a betatron type of accelerator. The principle of the synchrocyclotron (phasotron) was announced by Veksler (J Physics U.S.S.R. 9 153 (1945); Doklady Akad Nauk 44 No.9 (1944)) before McMillan (Phys Rev 68 143 (1945)). Veksler (J Physics U.S.S.R. 9 153 (1945); Doklady Akad Nauk 43 No.8 (1944) and 44 No.9 (1944)) suggested also the idea of the microtron and of the synchrotron.

239 Equipment for Automatic Resonance Control by Gunnar Lindström Arkiv Mat Astro Fysik 35A No.5 1-8 (1948)

An arrangement is given for maintaining near-resonance conditions, the principle of which may be applied to instruments requiring automatic resonance control. Essentially the method is that an amplified signal from the beam indicator of a cyclotron is fed into a mechanical chooser which alternately charges two condensers. These condensers are discharged in series into an amplifier in a way which maintains near-resonance conditions.

240 The Linear Accelerator by G R Newbery Electronic Eng 20 346-347 (1948) Nov

The two main types of microwave linear accelerators, i.e., the travelling and standing wave types, are described in non-mathematical language. Schematic diagrams illustrating the apparatus and principles are given.

241 A Magnetic Resonance Accelerator for Electrons by W J Henderson, H LeCaine and R Montalbetti Nature 162 699-700 (1948) Oct 30

A small electron accelerator which has been constructed on the "microtron" principle (Schiff, Rev Sci Instruments 17 6 (1946)), as suggested by Veksler (J Physics U.S.S.R. 9 No.3 153 (1945)), is

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described and a schematic diagram is shown. The accelerator is essentially an electron cyclotron, which overcomes the cyclotron limitation imposed by the relativistic increase in mass by using the fact that for a relativistic particle subject to periodic accelerations the difference in the time required to execute successive orbits in a magnetic field is a constant, and independent of the total energy of the particle. Thus, the magnetic field and the radio-frequency voltage are adjusted so that the time difference between successive orbits is equal to the period of the radio-frequency field. A cavity resonant at $\lambda = 10.7$ cm is contained in one side of a vacuum chamber placed between the poles of an electromagnet. Power is fed to the cavity through an evacuated wave-guide from a tunable magnetron. A stabilizing load and phase shifter operating in vacuum allow the adjustment of the loading of the magnetron. The accelerating gap in the cavity is 1 cm. Using a fluorescent target the circular shape of the electron orbits was verified. The electron current is shown as a function of orbit diameter for a 1000-oersted magnetic field. There is little, if any, current loss between orbit 2 and orbit 8. The resonance value of the magnetic field is found to be broad, and with a particular cavity eight successive orbits are obtained for values of the magnetic field anywhere between 900 and 1200 oersteds. This may be connected with the possibility that electrons with the required phase may cross the first gap with a range of energies. It may be possible to make use of this phenomenon in future designs to permit the use of higher magnetic fields and cavity voltages. In addition to the main resonance, other modes of resonance operation at lower magnetic fields are also observed.

242 A Note on the Shape of the Polepieces of a Synchrotron Magnet by N Davy Proc Phys Soc 60 598-599 (1948) June 1

Calculations are made to determine the shape of the polepieces for the Birmingham synchrotron magnet.

243 70-Million Volt Synchrotron by Richard H Oppermann J Franklin Inst 246 441-442 (1948) Nov

A 70-million volt synchrotron is being built for Queens University, Kingston, Canada, for research with high-energy x-rays. The machine, which is now under construction at the General Electric Company, will be installed in a special underground chamber to protect personnel from harmful radiations and will be operated from a remote control station.

244 The University of Chicago 170-Inch Synchrocyclotron, Progress Report by Herbert L Anderson and John Marshall. University of Chicago Institute of Nuclear Studies (Office of Naval Research Contract) July 1947-July 1948 166p (NP-451)

The University of Chicago synchrocyclotron is designed to produce protons of energy 450 Mev. The principal part of this machine is a 2200-ton electromagnet whose poles have a diameter of 170". In the conventional cyclotron the frequency of the alternating electric field is fixed, and it will no longer have the correct value once the kinetic energy of the ions whose motion is accelerated becomes appreciable compared to the rest energy. In the synchrocyclotron the frequency is decreased continuously by means of a rotating condenser so as to maintain the resonance condition. For 450 Mev protons the frequency must be varied from 28.3 megacycles per second (assuming a central field of 18,600 gauss) to 18.3 megacycles (assuming a magnetic field of 17,800 gauss at the outer orbit). The orbits of the ions in the synchrocyclotron have the property of phase stability. This means that there is a position of stable equilibrium in the phase of the ions with respect to that of the radio frequency. Active work on this project was begun in July 1947; the schedule calls for operation of the machine to begin before January 1950. This is an interim report covering the progress of all phases of design and construction after one year.

245 The Work of the BTH Research Laboratory Beama J 55 313-318 (1948) Sept

A novel form of betatron for accelerating electrons to 16 Mev energies has been built in the BTH Laboratory at Rugby for use in the Clarendon Laboratory at Oxford. A diagram of the betatron is shown; the two departures from established design are: 1) the A.C. magnetic field which guides

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and focuses the electrons is separate from the A.C. magnetic field used to accelerate them; 2) acceleration of the electrons takes place in a relatively small diameter evacuated tube (toroid or doughnut). The latter is a logical consequence of the separation of the two fields; the separation of function is accomplished by using separate field windings, which results in a reduction in the power input and weight required for a given output since the accelerating field is thus given a continuous iron path. Two betatron toroids are described. One of circular cross section formed from C.9 glass tubing into a 16 in. diameter circular ring is used in the betatron described. The other toroid, of rectangular cross section, is of novel design, being all-glass and formed by the annealing of two channel-shaped rings of C.9 glass in a specially built oven. Other researches at this laboratory are also discussed, i.e. lamp researches, miniature radio sets, infra-red detectors, a mass spectrometer leak detector, magnetrons, and insulations.

PETROLEUM

246 Radioactivity Well Logging by E N Tiratsoo Petroleum 11 2-6 26 (1948) Jan

Gamma-ray measurements of the radioactivity of sedimentary rocks show that a slower rate of deposition causes greater radioactivity, and that radioactivity of the different deposits varies. Listed in increasing order of activity, the deposits are: coal → salt → dolomite → limestone → sandstone → shale → organic shale → potash beds. The relative radioactivity of these beds is used in differentiating the strata, using the gamma log, and this method is described and discussed. Essentially, the method consists of lowering an ionization chamber, enclosed in a torpedo-shaped outer case, into the bottom of the hole, and taking the log upwards. The gamma-ray logs, besides distinguishing formations and assisting in their correlations, are also being used for location of fresh water sands in depleted wells; for holes in which the mud is contaminated with salt, making the electric log method very difficult to use for logging with oil base muds; for logging after the case has been cemented into place in conditions where very heavy muds must be used; for determining the exact height to which the cement has risen behind the casing, by mixing a little radioactive material into the cement (carnotite); and for getting more accurate depth measurements.

PHYSICS, GENERAL

247 Condensation of Pure He^3 and Its Vapor Pressures between 1.2° and Its Critical Point by S G Sydoriak, E R Grilly and E F Hammel. AECD-2395 (LADC-584) nd Decl Dec 3 1948 7p Proposed for publication in Phys Rev Document for sale by AEC

The isotope He^3 was produced from tritium solutions by the β-decay of tritium. The latter was initially separated from traces of He^4 by passage through a palladium valve. The He^3 was purified by absorption of hydrogen and tritium in uranium, followed by repeated passages successively over hot CuO and hot Ca, thus removing all other impurities except the rare gases. Laboratory procedures are described and vapor pressures of He^3 between 1.2° and 3.3° K are tabulated.

248 Solution of the Equation $\ddot{N} - (a - bt)\dot{N} - c - dt)N = 0$ by R R Coveyou and T W Mulliken. AECD-2407 (CNL-44) nd Decl Dec 9 1948 21p Document for sale by AEC

The problem posed by the above equation was suggested in connection with an experimental problem. The solution given requires the calculation of certain solutions of Weber's equation in some detail. Following reduction to standard form, the steps in the solution are indicated.

249 Separation of a Gas Mixture Flowing through a Long Tube at Low Pressure by R D Present and A J deBethune. AECD-2411 nd Decl Dec 14 1948 23p Proposed for publication in Phys Rev Document for sale by AEC

The separation of a binary gas mixture by diffusion through a capillary of radius r depends on the fact that the molecules have different masses m_i and mean speeds $\bar{v}_i$. When the inlet pressure is so low that the mean free path is much greater than r, the flow is diffusive and the separation

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factor (at zero outlet pressure) has its maximum value $(m_2/m_1)^{1/2}$. At high pressures ($\lambda \ll r$) no separation occurs. This paper treats the intermediate case ($\lambda \approx r$) where the transfer of forward momentum from light to heavy molecules in unlike collisions equalizes the transport velocities and decreases the separation factor. As the inlet pressure rises, this effect makes the flow non-separative before it becomes viscous. Flow equations are derived by equating the momentum acquired by the light component from the pressure gradient to the momentum lost to the wall plus that transferred to the other component. The viscous effects are treated as a small additive perturbation on the flow. The integrated flow equations express the separation factor as a function of the inlet and outlet pressures. 21 references.

250 Empirical Heat Capacity Equations of Gases and Graphite by Hugh M Spencer Ind and Eng Chem 40 2152-2154 (1948) Nov

Empirical heat capacity equations were obtained for solid graphite and for 117 gases, among which was boron trifluoride. Values for the constants in the equation are listed.

251 Ionization by Alpha-Particles in Liquids at Low Temperatures. Part 1. Measurements in Liquid Nitrogen and Liquid Hydrogen by A N Gerritsen Physica 14 No.6 381 (1948) Aug (In English)

The theories of Jaffé (Ann Physik (4) 42 303 (1913)) and Kramers (to appear shortly in Physica) concerning column ionization in liquids at low temperatures are discussed at some length. A suitable ionization chamber and a simple method for measuring the ionization currents thus produced by alpha particles are described. Diagrams of the chamber and measuring circuit are shown. Ionization was produced by the alpha particles from a polonium sample covered by a tin foil to reduce its intensity. Curves of the ionization current obtained as a function of the field for a field range of 0 to 20 kv/cm and for a range up to 200 kv/cm are given for liquid nitrogen (77°K) and liquid hydrogen (20.4°K). These are compared with curves calculated using Kramers' formula. Tabulated data for ratio of i/I (where i is the measured current in the liquid state and I the saturation current in the gaseous state) are shown as a function of the field strength for uncovered and covered specimens of both nitrogen and hydrogen. The linear relation between current and field in the case of nitrogen is attributed to the corrective influence of the diffusion on the distribution of the ions in the liquid. Kramers' theory proves to be in qualitative agreement with the results. However, further corrections in the theory are indicated since the calculated column diameter values deviate considerably from the known values in gas under normal conditions. The disturbing influence of the high ion concentration causing a strong initial recombination, and the assumptions of an initial Gaussian distribution of the columnar ions are suggested as possible sources of error. 2 diagrams, 5 tables, 5 curves, and 24 references.

252 Ionization by Alpha-Particles in Liquids at Low Temperatures. Part 2. Measurements in Liquid Helium and Argon by A N Gerritsen Physica14 407 Aug 1948. (In English)

Measurements similar to those obtained for nitrogen and hydrogen (Gerritsen, Physica 14 381, Aug (1948)) were made for the ionization produced by alpha particles in liquid helium and argon. Tabulated data and curves analogous to those obtained in Part 1 are shown. However, in contrast to nitrogen and hydrogen, the results obtained for argon and helium are not in agreement with the values obtained using Kramers' theory. It is argued that this may be due to the inadequacy of the assumption of an initial Gaussian distribution of the densities of ions along the path of the alpha particle; a correction calculated after assuming a spreading of the ratio between the local linear ion density and the local columnar diameter, bears this out. The currents obtained in the liquefied inert gases are 10 to 20 times larger than those obtained in liquid nitrogen and liquid hydrogen. This seems to indicate a much smaller value for the recombination of ions in liquid helium and liquid argon than that given by Langevin's classic expression. Apart from an irregularity in the immediate

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neighborhood of the λ-point, the currents in liquid helium are nearly the same both above and below the transition temperature. These results obtained with alpha particles are similar to those obtained using x-rays to produce the ionization. 7 tables and 8 curves.

253 Photoelectric Emission and Contact Potentials of Semiconductors by L Apker, E Taft, and J Dickey Phys Rev 74 1462-1474 (1948) Nov 15

The energy distributions of external photoelectrons from the semiconductors, Te, Ge, and B, were compared with those of several metals in spherical photo-tubes with interchangeable emitters. Contact potentials were determined from the saturation points of current-voltage characteristics. For the semiconductors, as contrasted with metals of the same work function, there were few electrons with energies near the Einstein maximum. In general form, the distributions could be described by the expression $N(\nu,E)dE \propto q(\nu)E(h\nu-\phi-\delta-E)^m dE$, based on simplifying assumptions analogous to those previously applied in the case of metals. Here ϕ is the work function; δ is the energy difference between the Fermi level and the top of the occupied band of energy states; m is a parameter depending both on the form of this band and on the energy dependence of the photoelectric excitation probability; q is a slowly varying function of ν. The photoelectric properties of the semiconductors could also be specified conveniently by plotting measured values of $N(\nu,E)/E$ as functions of $h\nu-\phi-E$. Spectral distributions of the photoelectric yields varied more rapidly with ν than those for metals and were not measureable unless $h\nu$ exceeded ϕ by several tenths of an electron volt.

Near the Einstein maximum, energy distributions deviated from the simple relation given above. The experiments failed to disclose sharply defined stopped potentials corresponding to upper edges of occupied bands of energy states in the semiconductors. Thus m and δ were not defined uniquely. Typical values of m obtained both from energy and spectral measurements were 3/2 and 2; illustrative values of δ were 0.10 to 0.18 ev for evaporated Te ($\phi \sim 4.76$ ev), 0.2 to 0.3 for evaporated Ge ($\phi \sim 4.8$), and 0.3 to 0.5 for pyrolytic films of B($\phi \sim 4.6$). Thermoelectric measurements showed that all samples were P type. For Te the results were in agreement with available data on electrical properties. Using the above values of δ, upper limits were found for photo-currents originating in the "forbidden" zones (as defined by $E > h\nu-\phi-\delta$). For the surface states that were assumed as possible sources of these currents, estimated densities were of the order of magnitude, $10^{12}cm^{-2}$.

254 The Velocity of Propagation of Electromagnetic Waves Derived from the Resonant Frequencies of a Cylindrical Cavity Resonator by L Essen and A C Gordon-Smith Proc Roy Soc 194A 348-361 (1948) Sept 2

The frequency of resonance of an evacuated cavity resonator in the form of a right circular cylinder is given by the formula $f = v_0\sqrt{\left[\left(\frac{r}{\pi D}\right)^2 + \left(\frac{n}{2L}\right)^2\right]\left[1 - \frac{1}{2Q}\right]}$, in which v_0 is the free-space velocity of electromagnetic waves, D and L are the internal diameter and length respectively of the cylinder, r is a constant for a particular mode of resonance, n is the number of half-wavelengths in the resonator, and Q is the quality factor. Assuming the validity of this equation the value of v_0 can be obtained from measured values of f, D, L, and Q.

A copper cylinder of diameter approximately 7.4 cm and length 8.5 cm was constructed with the greatest uniformity of diameter and squareness of end-faces, and its dimensions were measured. The resonant frequencies for a number of different modes were measured, and experiments were made to show that the effects on frequency of the coupling probes to the oscillator and detector were negligibly small. It was concluded from these measurements that the most favorable experimental conditions can be obtained for the E_{010} and E_{011} modes. Final measurements on these gave v_0 = 299,792 km/sec.

The estimated maximum error of the results is 9 km/sec (3 parts in 10^5). This is the error of a single measurement and, since most of the errors are not necessarily random, little is gained by

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making a large number of measurements. The value is 16 km/sec greater than the recently determined values of the velocity of light, although the results are not in disagreement when the combined limits of accuracy are taken into account.

PHYSICS, NUCLEAR

255 Quarterly Progress Report. MIT Research Laboratory of Electronics (Army Signal Corps Contract) Oct 15 1948 78p

The following topics of particular interest in the field of atomic energy are discussed: hyperfine structures and nuclear quadrupole moments of the halogens; the hyperfine structure and quadrupole moment of Al^{27}; a molecular-beam spectroscopy apparatus; theory of nuclear effects in microwave spectra; the nuclear spin and magnetic moment of Na^{22}; the nuclear spin and magnetic moment of Cs^{137}; a detector of low-energy ions; magnetic nuclear resonance; paramagnetic and ferromagnetic resonance absorption; microwave spectroscopy; and a linear accelerator program.

Other topics reported on are electron emission studies, chiefly with tungsten and thoria cathodes; microwave gaseous discharges; properties of helium at low temperatures; travelling-wave tubes; problems in communication research; and magnetron development.

256 Scientific Progress Report. Jan - July 1948. Brookhaven National Laboratory Report BNL-S-4 nd 51p

Information is given on the activities of the physics department, accelerator project, nuclear reactor project, chemistry department, biology department, medical department, engineering department, and on meterology and health physics.

257 Abstracts of Papers Presented at the AAAS Centennial Celebration Science 108 579-605 (1948) Nov 26

Included in the papers presented at a meeting of the American Association for the Advancement of Science held September 13-17 in Washington, D.C. were the following: Interactions of Matter and Radiation, by Willis E. Lamb; How Mesons Disappear, by John A. Wheeler; Sources of Energy, by Farrington Daniels; Second Thoughts to the Problem of Nuclear Energy, by Eugene P. Wigner; Cosmic Rays in the Stratosphere, by Marcel Schein; Influence of Modern Developments in Nuclear Energy upon Public Health Problems, by Stafford L. Warren; Oxygen Isotopes in Nature and in the Laboratory, by Harold C. Urey; Super-High-Energy Accelerators, by Leland J. Haworth; New Worlds for Study, by James Hillier; Elementary Particles of Physics, by Carl D. Anderson. Abstracts of most of these papers are given. The complete proceedings of this meeting in the form of a Centennial Volume edited by S. S. Negus should be published in 1949.

PHYSICS, THEORETICAL

258 Calculation Methods of Quantum Theory Illustrated by Problems and Solutions. Part I. Elementary Quantum Mechanics. The Fundamentals of the Mathematical Sciences in Specific Cases with Particular Consideration of the Fields of Application by Siegfried Flügge and Hans Marschall. Berlin and Göttingen, Springer-Verlag 1947 x + 240p Vol 53 (In German)

The author, after a brief introduction to the principles of elementary quantum mechanics, presents seventy-nine problems with their solutions. Topics for which several problems are included are the following: stationary states, illustrations of the meaning of certain operators, the traditional single-particle calculations using Dirac's equation, the case of two identical particles. Some of the methods of collision theory are illustrated, too. A short mathematical appendix containing condensed information is also included.

259 The Difficulties in Quantum Electrodynamics by P A M Dirac. Report of an International Conference on Fundamental Particles and Low Temperatures held at the Cavendish Laboratory, Cambridge. Volume I, Fundamental Particles, p 10-14 London, Physical Society

The difficulties in the formulation of the theory of quantum electrodynamics are discussed. By altering the choice of representation the author shows that it is possible to eliminate the divergent integrals usually obtained; however, the series thus derived for the wave function does not converge. Both difficulties are shown to have only superficial differences, and it is concluded that since both are independent of the representation, the wave equation never has a solution in the form of a power series in e. Another difficulty discussed is that the solution of the wave equation for a single electron in the absence of in-going radiation gives a continual emission of photons. The author concludes that the two most serious problems are the aforementioned and also the great complexity of the solutions of the wave equation for even the simplest problems. Although it may be necessary to get away from the point-charge theory of the electron to overcome these problems, the author concludes that this will probably involve even greater difficulties and suggests that new mathematical forms of the wave equation be sought instead.

260 Difficulties of Field Theories and of Field Quantization by W Pauli. Report of an International Conference on Fundamental Particles and Low Temperatures held at the Cavendish Laboratory, Cambridge. Volume I, Fundamental Particles, p 5-10 London, Physical Society

The two types of singularities occurring both in the problem of the interaction of a point electron with an electromagnetic field (including its own) and in that of the interaction of nucleons with the meson field are discussed, i.e., a) the point-model singularity, already contained in the classical theory, and b) the fluctuation singularities, which are essentially quantum-theoretical. Possible ways of attacking the elimination of these singularities are discussed. The author briefly derives the S-matrix, first used in this connection by Heisenberg (Z Physik 120 513 and 673 (1943)), preliminary to a discussion of proposed modifications of the final result in cases where the usual theory leads to divergences. The results are discussed along with the recent related work of Weisskopf and Wigner (Phys Rev 56 72 (1939)) and the Heitler-Wilson rule (given in this Conference Report, p 189) which gives a good approximation on some problems. The latter, however, is unsatisfactory in the following types of problems: 1) several nucleons or electrons present, 2) determination of meson field contribution to nucleon magnetic moments, 3) radiation losses of an electron in a force field. The importance of attacking problems of types 2) and 3), as test cases for a future theory, is noted.

261 The Factorization Method, Hydrogen Intensities, and Related Problems by T E Hull and L Infeld Phys Rev 74 905-909 (1948) Oct 15

The factorization method was used to calculate in an elementary way the discrete-discrete and discrete-continuous transition probabilities of hydrogen atoms by means of recurrence formulas. From

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a key intensity all others were found by a repeated application of an l-changing recurrence formula or an n′ -changing operator. The results are given for l-changing in the formulas: (4.2), (4.3); for n′ -changing in the formulas: (5.1), (5.2) with (3.2). Some of the formulas apply to more general matrix components.

262 Interaction Energy in Quantum Field Theory by Alex E S Green Phys Rev 74 1545 (1948) Nov 15 (Letter to the editor)

The author shows that an extension of Fock's treatment of quantum electrodynamics (Physik Z Sowjetunion 6 449 (1934)) which resulted in the explicit appearance of the coulomb interaction energy will also give the dynamic interaction energy. It is suggested that an analogous procedure may be used to obtain the total interaction energy in vector meson theory, in generalized electrodynamics, and in generalized meson theory.

263 On Feenberg's Perturbation Formula by Herman Feshbach Phys Rev 74 1548-1549 (1948) Nov 15 (Letter to the editor)

The author derives Feenberg's perturbation formulas (Phys Rev 74 206 (1948) and another in press), in which there are no repetitive matrix elements in the construction of a term of given order, directly from the eigenvalue problem by a method of successive approximations. It is noted that the procedure, which is briefly described, yields an exact expansion for any finite secular equation.

264 On the Interpretation of a Wave Function Turned toward the Past by V A Fok Zhur Eksptl i Teoret Fiz 18 737-740 (1948) Aug (In Russian)

The wave function is usually applied in quantum mechanics to the computation of probabilities relative to some future measurements, on the basis of results obtained from measurements previously taken. However, there are certain conditions in which the wave function can be used for the determination of probabilities in the past, if the results of subsequent measurements have been obtained. These conditions are laid down in the present article, and a formula is given for probabilities relative to the past. The formula contains, as an essential element, the a priori probabilities.

265 On the Quantization of Field Theories Derived from Higher Order Lagrangians by J S de Wet Proc Cambridge Phil Soc 44 546-559 (1948) Oct

The theory of quantization of fields, previously derived by Heisenberg and Pauli (Z Physik 56 1 (1929)) from a Lagrangian containing first derivatives of the field quantities only, is extended to the case of higher order Lagrangians. A method of expressing such equations in Hamiltonian form, obtained by extending Weiss's method of finding canonically conjugate pairs of variables (Proc Roy Soc 169A 102 (1938)) and carrying out the subsequent quantization, in either the Einstein-Bose or Fermi-Dirac formulation, is discussed. The relativistic invariance and consistency of the quantization are demonstrated. It is noted that the Hamiltonian in this presentation proves to be different, in general, from the 4-4 component of the energy momentum tensor. The present direct approach of the author is preferable, in his opinion, to Chang's indirect approach to this problem (Proc Cambridge Phil Soc 42 132 (1946)).

266 On the Particle Aspect of the General Mixed Meson Theory by H Adolf and S Eriksson Arkiv Mat Astron Fysik 34A No. 21 (1948) 15p

The present paper is a sequel to a paper published some years ago (Arkiv Mat Astron Fysik 29A No. 10 (1942)). The general mixed meson theory is investigated. It is shown that quantization according to Fermi-Dirac-statistics is possible. The state of things in the author's mixed theory is quite the same as in Dirac's electron theory. It is shown that equations can actually be written as four groups of Dirac's equations. Discussion is presented under the following headings: wave equations and fundamental quantities, introduction of new variables, the one-particle equation, the spin, neutral particles with spin = $1/2\,\hbar$. A comparison with current theories is made.

PHYSICS, THEORETICAL (continued)

267 On Schwinger's Theory of Nuclear Forces by W H Ramsey Proc Phys Soc 61 297-299 (1948) Oct 1

Schwinger's generalization of the Møller-Rosenfeld symmetrical version of the meson theory of nuclear forces (Kgl Danske Videnskab Selskab Mat-fys Medd 17 No. 8, (1940)) is shown to be inconsistent. Schwinger (Phys Rev 61 387 (1942)) proposed his generalization of the Møller-Rosenfeld theory to account for the difference in the experimental and theoretical values for the lower limit of the mass of a meson. The generalization retains the essential characteristics of the simple theory while giving a different radial dependence, since the latter was responsible for the failure of the Møller-Rosenfeld theory. In Schwinger's formulation the Møller-Rosenfeld theory appears as a special case in which the masses of the vector and pseudoscalar mesons are equal. The application of this to the different cases of proton-proton scattering is shown to result in an incorrect value for the quadrupole moment of the deuteron, demonstrating the inconsistency of the theory.

268 On Vector Transforms by John W Miles Phys Rev 74 1531 (1948) Nov 15 (Letter to the editor)

A method of direct formulation of the vector solutions of the vector wave equation, in which transorms for the vector eigenfunctions are introduced, is outlined. The solutions obtained are given both in Cartesian and polar coordinates.

269 Phenomenological Quantum Electrodynamics. Part II. Interaction of the Field with Charges by J M Jauch and K M Watson Phys Rev 74 1485-1493 (1948) Nov 15

The quantization of the phenomenological field is carried through with the presence of charged particles described by a Dirac Hamiltonian. The elimination of the longitudinal field presents some features which are qualitatively different from the vacuum case. In the first place the Coulomb energy has an angular dependent term. Furthermore, the elimination procedure introduces an additional term in the interaction Hamiltonian which is proportional to the medium velocity. The physical significance of this term is clarified in the discussion of the Cerenkov radiation which is carried through in the two coordinate systems: medium at rest, particle moving and particle at rest, medium moving. The result for the total radiation emitted is in agreement with the corresponding classical calculation.

270 Principia Physica by Hans Georg Küssner. Göttingen, Germany, Vandenhoeck & Ruprecht (1946) 256p (In German)

This book is divided into four main parts: I. The logical foundations of theoretical physics; II. The gravitation problem; III. Cosmological problems; IV. The arithmetic invariants of physics. Each part is divided into several logical subdivisions, the ones under "cosmological problems" being particularly interesting. This part includes the theory of high altitude radiation, with information on the fundamentals, the atomic nucleus model for mass radiation, the nuclear thermodynamic theory of σ disintegration, the intensity of radiation considering the absorption and angular distribution of the secondaries, comparisons of the theoretical and measured intensities, the shower and impulses, mesons, and examinations of the theory using new observations. The theoretical and experimental values of the fundamental constants are given. All material is covered in a purely theoretical and mathematical manner.

271 Quantum Electrodynamics. I. A Covariant Formulation by Julian Schwinger Phys Rev 74 1439-1461 (1948) Nov 15

This paper is the first in a series which will be devoted to the solution of some of the problems of quantum electrodynamics without the introduction of fundamentally new concepts. After stating the nature of the difficulties, the author proceeds to formulate a completely covariant electrodynamics. After a formulation in the Heisenberg representation, an interaction (mixed Heisenberg-Schrödinger)

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formulation which is of greater practical use is obtained by means of a canonical transformation. The covariant elimination of the longitudinal field, in which the customary distinction between longitudinal and transverse fields is replaced by a suitable covariant definition, is then discussed. Finally, the author describes collision processes in terms of an invariant collision operator, which is the unitary operator determining the over-all change in state of a system as the result of interaction. The collision operator is shown to be simply related to the Hermitian reaction operator and a variational principle is constructed from the latter.

272 Quantum Mechanics by L I Schiff. International Series in Pure and Applied Physics. New York, N. Y., McGraw-Hill Book Company Inc (1948) (Ready in November)

The author gives comprehensive treatment of the subject, emphasizing the physical significance of the mathematical formalism. Approximation methods, collision theory, field theory, and quantum electrodynamics are discussed in detail.

273 Relativistic Cut-Off for Quantum Electrodynamics by Richard P Feynman Phys Rev 74 1430-1438 (1948) Nov 15

A relativistic cut-off of high frequency quanta, similar to that suggested by Bopp (Ann Physik 42 573 (1942)) is shown to produce a finite invariant self-energy for a free electron. The electromagnetic line shift obtained for a bound electron agrees with that given by Bethe (Phys Rev 72 339 (1947); 73 1271A (1948)) and Weisskopf (Phys Rev 73 1272A (1948)). The radiationless scattering of an electron at a potential is discussed, and the cross section found to remain finite. However, the problem of polarization of the vacuum is not solved. Otherwise, the results in general agree essentially with those calculated by Schwinger (Phys Rev 73 415A (1948)). An alternative cut-off procedure analogous to one proposed by Wataghin (Z Physik 88 92 (1934)), which eliminates high frequency intermediate states, can be used to achieve the same results by may solve vacuum polarization problems as well.

274 Relativistic Hamiltonian System of a Particle and Relativistic Heisenberg's Equation by K H Tzou Phil Mag 39 790-799 (1948) Oct

Relativistic equations corresponding to the classical Hamiltonian equations of the motion of a particle in a force field are set up and used to derive a relativistic form of Heisenberg's equation. The relativistic Hamiltonian system obtained is discussed, and Dirac's equation is found to appear naturally as necessary form of the relativistic wave equation for the electron in quantum mechanics. Some applications of the relativistic Heisenberg equation to Dirac's theory are discussed, and it is noted that this equation results in a more symmetric form of some quantities, in the relativistic sense.

275 Superquantization. I by H J Groenewold Koninkl Nederland Akad Wetenschap Proc 51 977-989 (1948) Oct

A "superquantization" process which is concerned with many quantum particles is outlined by means of definitions within the ordinary quantum theory with its many-particle wave functions of classical particles. The author introduces wave operations as well as creation and annihilation operators into the ordinary quantum theory. The creation and annihilation operators act on the many-particle wave functions and describe the creation and annihilation of classical particles. Definitions are chosen within the old theory in such a way that the creations and annihilation operators and wave operators become isomorphic to those of superquantization. The formulation is accompanied by detailed definitions, and the various dynamical representations (Heisenberg and Schrödinger) are compared in outline form for both the elementary quantization and for superquantization.

276 Why Not Discard the Spinor Calculus? by Otto F. Fischer The Phil Mag 39 878-884 (1948) Nov

The author criticizes as too complicated the use of the "spinor calculus," which has been de-

PHYSICS, THEORETICAL (continued)

veloped in conjunction with the 2-dimensional Pauli matrices and the 4-dimensional Dirac matrices in order to extend the Schrödinger equation to the consideration of the magnetic and electric moments. This treatment has resulted in a replacement of the relativistic "world" structure of Maxwell's and d'Alembert's systems of equations with a number of new hypercomplex "unit" matrices. A return to the "world" system of the relativity theory, expressed synthetically in Hamilton's quaternions as previously indicated (Phil Mag 27 375 (1939); 30 135 (1940)), is suggested. By application of Hamilton's quaternions an apparently more natural and simple synthetic form for the generalized Schrödinger equation is obtained.

PUMPS

277 The Speed of Oil and Mercury Diffusion Pumps for Hydrogen, Helium, and Deuterium by B B Dayton Rev Sci Instruments 19 793-804 (1948) Nov

Data on several standard diffusion pumps indicate that the pumping speed for hydrogen may be considerably less than 3.8 times the rated speed for air depending on the jet design, pump fluid, heater input, and speed of the fore pump. Measurements of pumping speeds for a mercury diffusion pump with hydrogen, helium, air, argon, and freon made by Fluke (Rev Sci Instruments 19 665 (1948)) show that the speed is inversely proportional to the square root of the molecular weight, so that the speed ratio for hydrogen and air is 3.8. Evidence is presented that this reduction in speed is partly the result of diffusion of hydrogen back through the vapor jet from fore vacuum to high vacuum and partly the result of diffusion of hydrogen back out of the jet after entering from the high vacuum side. Measurements of the back diffusion of hydrogen, helium, and air in an experimental pump are correlated with the diffusion coefficient through an extension of the theories of Gaede (Ann Physik 46 356 (1915); Z Tech Physik 4 337 (1923)) and Matricon (J Phys et Radium 3 127 (1932)). The mechanism of jet breakdown has been observed with the aid of a glow discharge and a pilot dye. The results obtained are shown diagrammatically. 11 curves and diagrams and 4 tables.

RADIATION CHEMISTRY

278 The Effects of High Energy Radiations on Water and Aqueous Systems by F H Krenz Can J Research 26B 647-656 (1948) Sept (See NRC-1801)

In order to obtain a better idea of the effect that irradiated water has when biological systems are exposed to high energy radiation, the properties of the water were investigated. Evidence was obtained for vibrationally excited "polymers" of water which result in long lived activity. It is concluded that the large "indirect effect" of the water on biological systems may well be due to the properties of the "polymers." A cross section of the dilatometer used in measuring the water expansion upon gamma radiation, expansion curves and curves of lag effect in water and some aqueous solutions are presented. 35 references.

RADIATION SICKNESS

279 Clinical Reactions and Injuries in Supervoltage Therapy by Arthur Jones Proc Roy Soc Med 41 703-709 (1948) Oct

This brief account of the clinical effects of supervoltage radiation and of the injuries which have resulted during the treatment of malignant disease with the million-volt apparatus includes the following: (1) injuries to the skin and subcutaneous tissue, (2) injuries to connective tissue, (3) effects on respiratory tract, esophagus, bladder, bone, eye, and liver, and (4) occurrence of muscle fibrosis.

280 Inhibition of Testicular Hyaluronidase Activity by Rutin by Benjamin A Levitan Proc Soc Exptl Biol and Med 68 566-568 (1948) July - Aug

Rutin checked the spreading activity of intradermal injections of inked hyaluronidase markedly in the rat. It also inhibited the spread of ink injected as a control. The propylene glycol, used as the rutin solvent, had a somewhat inhibitory effect on hyaluronidase activity, caused probably as a result

RADIATION SICKNESS (continued)

of its slight shocking qualities and the resultant liberation of adrenalin with its hyaluronidase-activity inhibiting quality (Homburger, Yale J Biology and Med 17 479 (1944-1945)). However, it did not effect the spread of control injections of ink. 11 references, 1 table.

281 Rutin in Histamine Shock by Benjamin A Levitan Proc Soc Exptl Biol and Med 68 569-571 (1948) July-Aug

Pretreatment with large doses of rutin up to 2000 mg failed to protect rabbits against a minimum lethal dose of histamine. From the data gathered it would seem that rutin is without noteworthy antihistamine properties in the normal rabbit.

RADIOACTIVITY

282 The Beta-Ray Spectra of Cu^{64} by C S Wu and R D Albert. AECD-2403 (CUD-13; DR-1085) Nov 8 1948 Decl Dec 1 1948 8p Proposed for publication in Phys Rev Document for sale by AEC

Positron and negatron spectra of Cu^{64} have been investigated in the Columbia solenoid β-ray spectrometer. By using thinner and more uniform sources and employing a more rigorous Coulomb correction factor, the deviations at the low energy region were greatly reduced as compared with previous work reported from other laboratories. It seems probable that the remaining small observed deviation is instrumental and the Cu^{64} spectra are actually of the allowed type.

283 The β-Ray Spectrum of ThC″ D by D G E Martin, H O W Richardson and Yun-Kueihsu Proc Phys Soc 60 466-481 (1948) May 1

The energies of the β-rays of thorium C″ D have been measured using a magnetic spectrograph with semi-circular focusing. Corrections have been made for contamination of the source by ThC and ThB depositied by the processes of β-recoil and aggregate recoil. The absolute intensities of the stronger lines have been measured and the shape of the continuous spectrum has been compared with theory using three recently proposed energy level schemes for the product nucleus Pb^{208}. These level schemes fail to explain the observed shape, partly because they omit the P γ-ray (859 Kev) which can now be assigned to ThC″ D. Evidence for the β-excitation of energy levels at about 4.5 Mev is discussed. 25 references.

284 Beta Spectra of Active Isotopes Produced by Slow Neutron Irradiation of Cerium by L R Shepherd Research 1 671-672 (1948) Nov

The β spectrum of the activities induced in pure cerium oxide by slow neutron irradiation in the Harwell Pile has been examined using a thin lens spectrometer. A fairly thick source (c 5 mg/cm^2) was formed on thin aluminium foils and the momentum spectrum of electrons from this source was observed in the spectrometer. The observations were repeated on five occasions over a period of six weeks from the end of irradiation in order to observe the decay of different regions of the spectrum. A figure is given which shows a typical momentum distribution spectrum. Two groups of conversion electrons are present with peaks at 0.653 m_0c and 0.77 m_0c. These correspond to K and L conversion groups due to a transition of energy 0.141 $\pm$ .001 Mev. A Kurie plot of a typical set of observations on the β spectrum is shown. The partial spectrum which was observed to decay with a half life of 15 $\pm$ 2 days was attributed to Pr^{143}. Partial spectra which were found to decay with a half life of 32 $\pm$ 2 days were assigned to Ce^{141}. It is assumed that the 0.41 transition took place in Pr^{141}. The mean value obtained from all the plots gave 30 per cent of the Ce^{141} particles in the upper partial spectrum and 70 per cent in the lower spectrum. A proposed decay scheme is shown. An estimate of the conversion ratio of the 0.141 Mev transition in Pr^{141} was α = 20 per cent. The gamma radiation from the active cerium consisted almost entirely of very soft rays corresponding to the 0.141 Mev transition. Coincidences were observed between the K conversion electrons focused in the spectrometer and β particles recorded in an end-on β counter placed behind the sources. 2 references.

RADIOACTIVITY (continued)

285 Converted Gamma-Radiation from Silver, Cadmium, Indium, Praseodymium, and Rhenium by J M Cork, R G Shreffler and C M Fowler Phys Rev 74 1657-1659 (1948) Dec 1

Using a β-spectrometer and absorption methods the half-lives and energy characteristics of radioactive isotopes of silver, cadmium, indium, praseodymium, and rhenium have been determined. The activities studied were induced by neutron capture in the pile. Silver of half-life 282 days had gamma rays of energy 114.2, 655, 880 Kev, and 1.38 Mev. Cadmium appears to yield several radioactivities one of which is a positron emitter, and converted gamma rays of 86.3 and 336.9 Kev are observed. The well known 48-day activity in indium has a converted gamma ray whose energy is more closely determined as 190.9 Kev. Praseodymium also displays a complex decay curve, but associated with a short half-life previously reported as 19.2 hours are gamma rays of 133.7, 328.9, 489.6, and 624 Kev, and by absorption a high energy gamma ray of 2.1 Mev. Rhenium is strongly activated in the pile, yielding two radioactivities of half-lives 16 hours and 91 hours. A converted gamma ray of 153.6 Kev is found for the short-lived activities, and gamma energies of 122.7, 135.8, 127.5, and 640 Kev exist for the longer-lived activity.

286 Decay Scheme of Hf^{181} by A Hedgran, N Hole and J Benes Arkiv Mat Astron Fysik 35A No. 33 (1948) 9p

With a magnetic lens spectrometer, the authors studied the β- and γ-radiations of Hf^{181} and found the upper limit of the β-spectrum to be 460 Kev, while the disintegration is accompanied by three γ-quanta of 128, 342, and 472 Kev. The half life of Hf was determined to be 47 days.

287 The Delayed Coincidence Method in the Study of Radioactivity with Application to Isomerism in ^{181}Ta by D E Bunyan, A Lundby, A H Ward and D Walker Proc Phys Soc 61 300-306 (1948) Oct 1

The method of delayed coincidences has been applied to the study of the decay of the previously reported 22-microsecond metastable state in Ta^{181}, which is formed in the decay of the β-ray emitter Hf^{181}. It is shown that the isomeric transition takes place in two steps of 0.2 Mev and 0.5 Mev in instantaneous succession. The half-life of the metastable level has been redetermined as $(20.1 \pm 0.7) \times 10^{-6}$ seconds. From a comparison of the observed and calculated internal conversion coefficients, it seems probable that the 0.2 Mev and 0.5 Mev transitions are of an electric octopole and electric quadrupole character respectively. This would mean that since the spin of the ground state of Ta^{181} is 7/2, the 0.5 Mev state must also have a spin of 7/2 and the same parity as the ground state, while the metastable state must have a spin of 1/2 and opposite parity. The decay scheme and absorption and integrated decay curves are shown.

288 The Disintegration Scheme of I^{131} by Franz Metzger and Martin Deutsch Phys Rev 74 1640-1644 (1948) Dec 1

The radiations of I^{131} have been studied with a magnetic lens spectrometer and coincidence techniques using "Kallmann" counters. Four gamma rays of 80, 283, 363, and 683 Kev were detected both by their internal conversion electrons and by photoelectrons emitted from different converters. It was found that a β-ray spectrum of 600-Kev maximum energy occurred in about 85% of the disintegrations, leading to a state of Xe^{131} with 363-Kev excitation. In about 6% of the disintegrations, the transitions from this level to the ground state took place by the successive emission of an 80-Kev and a 283-Kev gamma ray. Fifteen percent of the disintegrations took place with the emission of a 315-Kev β-spectrum followed by a 638-Kev gamma ray. On the basis of these studies a disintegration scheme for I^{131} is diagrammed.

289 Energy Diagrams for Beta-Disintegration by A L Hughes Amer J Phys 16 415-420 (1948) Nov

Various ways of representing nuclear energy transitions by means of diagrams and the lack of

RADIOACTIVITY (continued)

uniformity in the literature are described. The author attempts to clarify the situation by discussing different representations of the various transitions and the interpretation of the diagrams involved. Equations and corresponding diagrams are shown for the following: beta-ray emission, positron emission, K-capture, and gamma-ray emission. For each of the preceding, two cases are considered, i.e., that in which the binding energy is neglected and that in which the binding energy is taken into consideration.

290 Energy Problems with Artificially Radioactive As^{76} by K Philipp and F Rehbein Z Physik 124 225-243 (1948) (In German)

The activities of As^{76} have been investigated and a value of 26.1 ± 0.3 hr. has been obtained for the half-life. The beta and gamma activities were detected by means of a β-spectrometer and coincidence counting techniques. The complex nature of the β-spectrum was verified and beta-gamma coincidences measurements indicated the existence of three partial spectra with end-points of 1.1 ± 0.1, 2.7 ± 0.2, and 3.15 ± 0.15 Mev. Coincidence absorption measurements of Compton electrons gave a γ-ray energy of 2.1 ± 0.05 Mev, while a group of weak photoelectron lines in the β-spectrum in the region 0.3-0.7 Mev indicate further γ-rays of corresponding energies. A disintegration scheme based on these data is given.

291 Excited Level in Li^7 from the Li^6(d, p)Li^7 and Be^9(d,α) Li^7 Reactions by W W Buechner, E N Strait, C G Stergiopoulos and A Sperduto Phys Rev 74 1569-1574 (1948) Dec 1

An annular magnet designed especially for the investigation of nuclear levels is described (Buechner, Van de Graaff, Strait, Stergiopoulos, and Sperduto, Bull Amer Phys Soc 23 No. 3 30 (1948)), and a schematic diagram is shown. The magnet was used to determine the difference in energy of the particles from the Be^9(d, α)Li^7 and Li^6(d, p)Li^7 reactions. These energies have been measured through a direct comparison with the α-particles from polonium, and they serve to determine the energy of the level in Li^7 excited in these processes. The values obtained are 482 ± 3 Kev for the Be^9(d, α) reaction and 483 ± 6 Kev for the Li^6(d, p) reaction. Curves of the number of tracks as a function of the field strength are shown for the α-particles and protons from the two reactions.

292 A Further Study of the γ-Radiation From Polonium by B Zajac, E Broda and N Feather Proc Phys Soc 60 501-508 (1948) June 1

Absorption experiments using lead, gold and tungsten have shown that, in addition to the known γ-radiation of 0.77 Mev energy, polonium emits other (soft) radiations of which the most intense has a quantum energy of 84 ± 4 Kev. The intensity of this radiation is of the same order of magnitude as that of the hard radiation (roughly one quantum per 10^5 disintegrations). Experiments by the recoil method indicate that the emission of the polonium γ-radiation is not delayed by more than 10^{-1} sec. The results of Chang (Phys Rev 69 60 (1946)) concerning the fine-structure of the α-particles of polonium remain uncorrelated with all other experimental evidence. While present information regarding γ-ray energies and intensities may be reasonably explained, satisfactory explanation of the α-particle fine structure "data" appears as remote as ever. 14 references.

293 Gamma-Rays from Proton Bombardment of Separated Argon Isotopes by K J Brøstrom, T Huus and J Koch Nature 162 695-696 (1948) Oct 30

Separated argon isotopes have been obtained by collecting argon atoms in a metal surface by a method previously used by several workers (Lindh and Nilsson Arkiv Mat Astron Fysik 31 (1944); Koch Nature 161 566 (1948)). The argon targets were made by bombarding silver disks with the separated beams of the argon isotopes, and were used to search for capture resonances for protons in the 0.5 to 1.8 Mev range in the isotopes A^{40} and A^{38}. The techniques of proton bombardment and gamma-ray detection used have been previously described (Brøstrom, Huus and Tangen Phys Rev 71 661 (1947)).

RADIOACTIVITY (continued)

Tabulated data for the resonance energies and yields for four A^{40} targets are given below:

E (Kev)	900	1050	1080	1100	1235
Y (counts/micro-coulomb)	0.2	0.4	0.5	1.0	0.5

No gamma radiation was found for A^{36}. The relative concentration of argon to silver atoms in the targets used was about 1:10. From this proton width for the 1100-Kev resonance is estimated as of the order of a few electron volts. Theoretical considerations are discussed and it is concluded that the results obtained are in agreement with the theoretical predictions.

294 Half-Life of $UX_1(Th_{234})$ by G B Knight and R L Macklin Phys Rev 74 1540-1541 (1948) Nov 15 (Letter to the editor)

This article is based on AECD-2260. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. 1185.

295 On the Radioactivity of K^{40} by O Hirzel and H Wäffler Phys Rev 74 1553 (1948) Nov 15 (Letter to the editor)

Experimental evidence is presented which indicates that the maximum beta-ray energy of K^{40} of 1.7 ± 0.1 Mev, recently obtained by Franchetti and Giovanozzi (Phys Rev 74 102 (1948)), is probably too high. The authors previously obtained a value of 1.41 ± 0.02 Mev (Helv Phys Acta 19 216 (1946)). Aluminum absorption curves obtained for P^{32} and Na^{24}, having maximum beta energies of 1.71 and 1.41 Mev, respectively, were compared with data for K^{40} in the same geometrical arrangement. The K^{40} curve is shown to agree closely with the lower energy Na^{24} curve. In addition, G-M counter measurements were made which gave a value of 8.7 ± 1.2 gamma quanta per 100 beta rays in the decay of K^{40}. The value obtained for the half-life of K^{40} was $(11.1 \pm 1.9) \times 10^9$ years.

296 The Photo-Disintegration of Be^9 by A Borsellino Nuovo Cimento 5 263-273 (1948) Aug (In Italian)

The threshold energy for the photoelectric disintegration of Be^9 is 1.63 Mev and this is the binding energy of the photodisintegration neutron. In a rough estimate one may assume that the nucleus of Be^9 is a two-body system (a neutron + Be^8). It is then possible to calculate the probability of transition from the ground state of the system to a state of positive energy due to the absorption of a γ-ray. The cross-section of this effect is calculated assuming that the neutron is bound in a rectangular hole which has a depth V_0 and a width r_0. For a width of 4×10^{-13} cm the depth is calculated to be $V_0 = 17.5$ Mev and for a width of 5×10^{-13} cm the depth is 12.1 Mev. A table is given which presents the values of the different relevant quantities for different widths. A figure is included in which the results are plotted for the values of the width $r_0 = 4 \times 110^{-13}$ cm and 5×10^{-13} cm. In the same figure the experimental results which are few and very scattered are also plotted. Best agreement with the experimental values corrected (according to Houtermans and Bartz, Physik Z 44 167 (1943)) are obtained, taking r_0 equal to 5×10^{-13} cm. 12 references.

297 Radiations from W^{187} by N Hole, J Benes and A Hedgran Arkiv Mat Astron Fysik 35A No. 35 (1948) 8p

With a magnetic-lens spectrometer, the β- and γ-radiations of W^{187} were studied. The β-spectrum is complex with upper limits of 1.34 and about 0.65 Mev, while from the secondary electron spectrum, γ-quanta with 129, 462, and 652 Kev energies were found. Possible decay schemes as well as data of γ-γ and β-γ coincidence measurements are given.

298 Radioactive Arsenic Isotopes by D A McCown, L L Woodward and M L Pool Phys Rev 74 1315-1319 (1948) Nov 15

Simultaneous alpha-particle bombardments of Ge^{70}, enriched electromagnetically to 90 percent, and germanium of normal isotopic constituency have established the location of an arsenic activity of

RADIOACTIVITY (continued)

76 ± 3 days' half-life at mass number 73. The decay takes place by K-capture into Ge^{73}, the energy of the gamma ray emitted being about 0.10 Mev. The half-life of As^{74}, measured over 10 half-lives, is 17.5 ± 0.1 days. Simultaneous deuteron bombardments of two selenium samples, enriched, respectively, in isotopes 74 and 76, have established the location of the 1.08-day arsenic activity at mass number 72. A radioactive arsenic isotope of 2.08 days' half-life has been produced by deuteron bombardment of germanium and is assigned to As^{71}. Decay and absorption curves for the activities observed are given.

299 Radioactive Isotopes of Ga and Ge by D A McCown, L L Woodward and M L Pool Phys Rev 74 1311-1314 (1948) Nov 15

The radioactive germanium isotope of 1.65-day half-life has been produced by Zn(α,n), Ga(d,2n), and Ge(n,2n) reactions, but not by deuteron bombardment of germanium. This isotope is reassigned and placed at Ge^{69}. It decays with emission of positrons, x-rays, and gamma rays. No evidence for the existence of the 195-day period previously reported (Mann, Phys Rev 54 649 (1938)) has been found for Ge^{69} after deuteron bombardment of gallium. The characteristic x-ray lines of gallium from decay activity of the 11.4-day Ge^{71} have been photographed by a curved crystal camera. Deuteron bombardment of Ge^{76}, enriched electromagnetically to 70 percent, has given no evidence of a 9-day period at Ga^{74} as previously reported (Sagane, Miyamato, and Ikawa, Phys Rev 59 904 (1941)). The half-life of Ge^{75}, produced by fast neutron bombardment of arsenic, is 1.37 ± 0.02 hours and the half-life of Ga^{67}, produced by alpha-particle bombardment of zinc, is 3.26 ± 0.02 days. Decay and absorption curves for the various observed activities are shown.

300 Radioactivity. Part II. Electrochemistry of Radioactive Substances and of Extremely Dilute Solutions by M Haissinsky. Paris, Hermann, 1946 68p (French)

The book is divided into six chapters and an appendix: I, Remarks on the chemistry of radioactive bodies; II, Electrochemical remarks; III, Technical remarks; IV, Theoretical considerations; V, Electrochemistry of natural radioelements; VI, Electrochemistry of artificial radioelements. After a general discussion of radioactivity and electrochemistry in the first two chapters, the author goes into detailed descriptions of equipment used and provides sketches for same. The theoretical aspect of the problem and the electrochemistry of the naturally and artificially radioactive elements is reviewed in the last three chapters. The appendix contains a table of natural radioactive isotopes and their half-lives, and a table of the normal electrochemical potentials of the metals. Bibliography contains 76 references.

301 The Radioactivity of Rb^{87} by T Fazzini and S Franchetti Nuovo Cimento 5 311-324 (1948) Aug (In Italian)

By means of a He filled cloud chamber (with magnetic field) the spectrum of Rb^{87} β-rays has been studied. Stereoscopic pictures of the tracks were not taken, but a method has been developed to correct the spectrum from the distortion arising from neglecting one of the velocity components. The end point is found to be much higher than usually reported, namely (5.6 ± 0.7) x 10^5 ev. In the high energy region the amount of electrons is very small and (unlike other forbidden transitions in light elements as Na^{24} or P^{32}) the general form of the spectrum seems to differ markedly from that of allowed transitions. A detailed discussion of this difference, including consideration of the thickness of the source, which was comparatively light (2.1 mg/cm^2), and absence of radioactive impurities lead to the conclusion that it must be a real one. With the same cloud chamber (air filled) and 50 grams of RbCl a search was made for conversion electrons from γ-rays. Existence of γ-rays of energy greater than 60 Kv in number comparable to that of disintegrations can be excluded. 20 references.

RADIOACTIVITY (continued)

302 The Threshold Energies of the Isomeric States of Rhodium 103 and 104 by Von Arnold Flammersfeld and Otto Bruna Z Naturforsch 2 241-244 (1947) May (In German)

The threshold energies of the isomeric states of rhodium were determined by measuring the range of the conversion electrons. The secondary electrons emitted by Rh^{104*} (half life = 4.3 min) have a range of 8.9 mg/cm² in Al corresponding to an energy of 87 Kev. The rotation impulse differential is estimated to be $\Delta i = 4$, and since most of the electrons are released from the L and (M + N) shells, the threshold energy of the excited state is 87 Kev. From the intensity of the electrons it can be deduced that the isomeric transition takes place 100% by the emission of these secondary electrons and that there is no direct transition from Rh^{104} to Pd^{104}. Rh^{103*} which is produced by the action of fast neutrons on stable Rh^{103} has a half life of 52 ± 2 minutes and emits conversion electrons of 2.1 mg/cm² range. Since the rotational impulse differential is estimated to be $\Delta i = 4$, the electron energy is equal to the threshold energy, this is 42 Kev. The quanta previously recorded are X-rays.

RADIOGRAPHY

303 Autoradiographs of C^{14} Incorporated in Individual Blood Cells by George A Boyd, George W Casarett, Kurt I Altman, Thomas R Noonan and Kurt Salomon Science 108 529-531 (1948) Nov 12

This article is based on AECD-2277. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. I-1195.

304 The Clinical Importance of the Autoradiographic Method Using Shortlived Artificially Radioactive Isotopes (Auto-organographs, Autoangiographs) by J H Muller Experientia 4 406-407 (1948) Oct 15 (In German)

The author demonstrates the possibility of making large autoradiographs on living humans after intravenous injections of an artificial radioactive isotope of a relatively short activity. Strong preparations (100 millicuries) of radiozinc (Zn^{65}) in the form of soluble oxide have been employed. These injections were given to two patients suffering from general carcinosis. Human auto-organographs (autohepatographs, automanmographs, autonephrographs, etc.) as well as the autoangiographs of the blood vessels of the skin and the subcutaneous tissues were thus obtained for the first time. The possibilities of clinical use of such autoradiographs are discussed briefly.

305 Sensitivity and Exposure Graphs for Radium Radiography by H E Johns and C Garrett Can J of Research 26A 292-305 (1948) Sept

The radiography of steel by the use of the gamma rays from radium is discussed. The thickness of lead front screen which yields the maximum intensifying effect is determined and the action of the front screen discussed. Sensitivity curves are obtained using a slotted wedge steel penetrameter for a number of the commonly used types of x-ray film. It is shown that the thickness of the lead front screen which produces the maximum density on the film is not necessarily the most useful thickness for gamma radiography. The most useful thickness is determined from penetrameter sensitivity curves. The importance of these sensitivity curves for routine gamma-ray testing is indicated. Density curves and sensitivity curves for various films are given.

RADIOTHERAPY

306 Clinical and Laboratory Studies on the Uptake of Radioactive Phosphorus by Lesions of the Breast by H McCorkle, B Low-Beer, H Bell and R Stone Surgery 24 409-415 (1948)

Useful data for the clinical, radiologic and pathologic study of breast lesions was obtained by Geiger-Müller counter measurements of radioactivity made over breast lesions following the administration of tracer doses of P^{32}. At present the method cannot be used for radiation therapy of breast lesions.

RADIOTHERAPY (continued)

307 Million-Volt X-Ray Research at St. Bartholomew's Hospital by N S Finzi Proc Roy Soc Med 41 719-720 (1948) Oct

The object of this research was to determine whether there was any advantage in the million-volt over the 200 kv machines either by increasing the proportion of successful results or by getting these results with less disturbance of the healthy tissues or the patients' general health. The author concluded that the million-volt machine was more accurate and that results were obtained with far less damage to normal tissues. It appeared that in intrinsic larynx and antrum cases especially, improvement was the result of biological difference, but in most other cases the improved results could be attributed to physical differences and in the case of skin to a chemical effect.

308 Million-Volt X-Ray Therapy by I G Williams Proc Roy Soc Med 41 709-718 (1948) Oct

From an analysis of the results of the treatment of carcinoma by means of X-rays generated at one million volts it appears that no very marked difference or improvement can be shown in survivals. 726 cases, some in very advanced stages of dissemination, were studied. It was observed that the tumors that respond poorly to ordinary X-ray therapy showed no very marked differences in response to million-volt therapy, with the possible exception of carcinoma of the rectum, bladder, antrum, or larynx. There was no evidence of any biological difference in response due to the shorter wavelength used. Any improvement in results was believed to be due to the physical advantages of greater penetration, and greater accuracy due to ease of application. The question of dosage was not clarified. For instance, many tumors recurred in treated areas following heavy irradiation, but others were arrested by 3000 r in 14 to 21 days.

309 Radioactive Iodine: Physiological and Clinical Studies Ann Internal Med 29 965-972 (1948) Nov (Editorial)

The purpose of this brief summation is to review some of the pertinent physiological and clinical data which have been accumulated concerning radioactive iodine. 21 references.

310 Radiotherapy in Dermatological Conditions by R T Brain Brit J Radiology 21 501-507 (1948) Oct

This general treatment of the subject includes the following topics: physical effects of radiation, quality of radiation, measurement of dosage, biological effects of radiation, clinical effect of radiation on skin, and the action of x-rays in disease. 7 references.

311 The Relation of Radiosensitivity and Radiocurability to the Histology of Tumor Tissue by Alfred Glücksmann Brit J Radiology 21 559-566 (1948) Nov

From a review of the literature it is determined that: (1) radiosensitivity of tumor tissue is not linked with its radiocurability; (2) the preponderance of short-lived undifferentiated cells and thus the degree of anaplasia determines the degree of radiosensitivity of tumors, as measured by the rate of tumor shrinkage; (3) the radiocurability of tumors — measured by the five-year symptom-free rate — varies with the degree of differentiation of the tissue and inversely with the growth-coefficient and the tendency to metastatic spread; (4) the reduction of radiocurability of tumors by lymphnode involvement is due to the biological character of such tumors rather than to differences in response of tumor tissue at primary and secondary sites and;(5) the capacity for increased differentiation under radiation distinguishes most of the radiocurable tumors. 114 references, 2 tables, 7 graphs.

RARE EARTHS

312 Determination of Rare Earth Elements and Yttrium in Uranium Compounds by H G Short and W L Dutton Analyt Chem 20 1073-1076 (1948) Nov

Using a Hilger Automatic Littrow model spectrograph furnished with quartz and glass trains, the authors have developed a method for the determination of rare earth elements together with yttrium

RARE EARTHS (continued)

in uranium and its compounds. The extraction of rare earth complexes was attempted with organic solvents (supferron at various pH values, sodium diethyldithiocarbamate, and benzoin oxime, sebacic and other organic acids, α-naphthol, and α-nitroso β-naphthol) but no satisfactory method could be found. Direct precipitation as oxalate, hydroxide using ammonia, and fluoride also proved unsatisfactory. It is seen that the bulk of the uranium must be separated first. This was done by extraction of an ether solution of nitrates with small amounts of water, whereby the rare earths pass into the aqueous layer. The rare earths are then precipitated as fluorides and subsequently purified as hydroxides. The spectrographic method may then be used. High sensitivity is obtained. The lines used for identification and estimation of the elements are given, as are data on the recoveries and determination.

313 Spectrographic Determination of Rare Earth Elements in Uranium Compounds by Robert C Hirt and Norman H Nichtrieb. Analyt Chem 20 1077-1078 (1948) Nov (See also MDDC-903)

This article is based upon MDDC-903. An abstract of the document appeared in Abstracts of Declassified Documents I 551 (1947) Nov 30

SCIENTIFIC RESEARCH AND LABORATORIES

314 Installation of Chemical Research Laboratory by H Sheinberg and R L Thomas. Los Alamos Scientific Laboratory Report LAMS-682 Jan 27 1948 19p

In connection with a general research program of alpha-emitting radioactive materials, a special laboratory was required. Since the quantities to be handled were larger than tracer scale, this laboratory had to meet rather stringent requirements because of the toxicity of the materials. These special requirements were: all units in which active material are handled must be individually vented; the layout must be such that air transfers of active material are reduced to an absolute minimum ;no active materials need be handled except inside vented enclosures and with rubber gloves; adequate storage facilities for radioactive material must be provided ;equipment must be easy to decontaminate. These above requirements were in addition to those of safety and convenience common to all standard chemical research facilities. The design and facilities of the laboratory are described. Drawings and photographs are supplied.

315 Atomic Energy Commission Fellowships J Amer Med Assoc 138 892 (1948) Nov 20

The Commission has established a fellowship program for physicians who desire to be trained and carry on research in the field of atomic energy as it relates to medicine. It will be administered by the National Research Council. Applicants must be under 35 years of age and have had 1 year of internship or its equivalent. The 1-year fellowship may be renewed. After approximately 6 months of basic training the fellows will have an opportunity to take part in various research projects supported by the Commission at various institutions throughout the country. Basic stipends of postdoctoral fellowships are $ 3000 a year and predoctoral are $ 1600 a year, and these may be increased to provide for special needs of the fellows.

316 AEC to Establish Chemical Laboratory Bull Atomic Sci 4 252 (1948) Aug

A new chemical laboratory for the precise analysis of special materials used in the atomic energy program will be established by the AEC in New Brunswick, N. J. The new laboratory will have facilities for the quality control of the uranium, beryllium, and other ore processing as well as other materials of importance. It is hoped that the laboratory will function fully by fall.

SCIENTIFIC RESEARCH AND LABORATORIES (continued)

317 The Atomic Energy Project of the National Research Council and Its Contribution to Canadian Research by W B Lewis Proceedings of the Conference on Nuclear Chemistry, Part I 16-19. Ottawa, Chemical Institute of Canada (1947)

The Atomic Energy Project of the N.R.C. is located at Chalk River about 130 miles from Ottawa. The project is engaged at present mainly in setting up experimental facilities for furthering the objectives of: obtaining data for engineers for atomic power development; nuclear physics research; preparation of tracers for experiments in biology, chemistry and metallurgy, and the preparation of radioactive sources for therapeutic work; research on the chemistry of radioactive elements and isotopes. A small nuclear-fission chain reacting pile called the Zeep is in operation and this is described briefly.

318 New Laboratories Phys Today 1 No. 7 31 (1948) Nov

B. F. Goodrich Company recently opened a new research center at Brecksville, Ohio. The program includes research on the application of nuclear energy to rubber manufacture. In Karaikudi, South India, the Electrochemical Research Institute is building a new million dollar laboratory. Problems to be investigated include the production of heavy water.

319 Researches in Progress in the Department of Natural Philosophy, the University, Edinburgh by N Feather British Science News 1 No. 12 2-5 (1948)

Researches in progress at the University of Edinburgh are described. These include work on the following: magnetic spectroscopy of β-particles and electron focusing, an electron multiplier, the study of radioactive disintegrations, balloon flights for meteorological and cosmic ray data.

320 Russia's 3 "Oak Ridges" by Albert Parry Science Digest 24 No. 6 25-29 (1948) Dec

Information on the development of atomic energy in Russia, obtained principally from unofficial reports of expatriates, is discussed. Three Atomgrads ("Atomic Cities") are believed to be in existence in Asia. One is located in south-central Siberia in the Kuznetsk Basin, one near Lake Baikal, and one in the Tuvinian Region. The first-mentioned is the primary center and contains atom-bomb shelters for the government in the event of war. The social implications of Russia's production of atom bombs in the future are mentioned.

SPECTROSCOPY

321 The Direct Spectrochemical Analysis of Solutions Using Spark Excitation and the Porous Cup Electrode by Cyrus Feldman. AECD-2392 (ORNL-131) Feb 1 1948 22p For publication in NNES; for proposed publication in Analytical Chemistry

An abstract of this document was assigned the number MDDC-1752. The abstract was listed in Abstracts of Declassified Documents I 184 (1948) Mar 31 This document is also a revision of AECD-2035.

322 The Classification of the Odd Terms of Ti I by F Rohrlich Phys Rev 74 1381-1396 (1948) Nov 15

The odd configurations $3d^24s4p$, $3d^34p$, and $3d4s^24p$ of Ti I are calculated using the results of a previous paper (Phys Rev 74 1372-1380 (1948) Nov 15.) Numerical values for the F^k and G^k integrals are found by comparison with the observed levels by a method of successive approximation. A correction is applied for configuration interaction which improved the general agreement. Explicit formulas are given for the multiplet strengths of transition arrays involving equivalent electrons and are applied to the transitions d^2sp-d^3s and d^2sp-d^2s^2 of Ti I. Tables of multiplet strengths are calculated corresponding to interaction energies diagonal in first-order and second-order eigenfunctions, respectively. On the basis of these calculations and known measurements of line intensities and gf values, a new classification of the odd terms of Ti I is proposed. Of the 83 observed odd terms, 76 were classified. In 74 cases the calculated terms fit with a mean deviation of ± 1023 cm^{-1} on a range of about

SPECTROSCOPY (continued)

30,000 cm^{-1}. Although the experimental data on multiplet strengths are rather scarce, they seem to be in better agreement with theory when based on the new classification.

323 Effect of Nuclear Motion on the Fine Structure of Hydrogen by G Breit and G E Brown Phys Rev 74 1278-1284 (1948) Nov 15

The effect of nuclear mass motion on the fine structure of hydrogen is re-examined from the point of view of the Hamiltonian applicable to two charged particles and accounting for effects of the order v^2/c^2, where v is the velocity. The work differs from that of Bechert and Meixner (Ann Physik 22 525 (1935)) in that the energy of the Dirac electron in a central field is taken as the reference point. The solution is carried out in terms of an eight-component rather than a four-component Dirac approximation (Proc Roy Soc 117A 611 (1928)) to the 16-component wave function. The result is the same for practical purposes as that of Darwin (Proc Roy Soc 118A 654 (1928)) for the prequantum-mechanical problem and of Bechert and Meixner for the four-component approximation. The energy formula is affected only by the original Bohr reduced mass correction to the term value and also by a term which is independent of the particular fine structure component, depending only on the principal quantum number. Bethe's electrodynamic shift (Phys Rev 72 339 (1947)) is, therefore, not obscured to within terms of relative order $\alpha^2(m/M)$ by the effects of nuclear motion.

324 Geometrical Factors Affecting the Contours of X-Ray Spectrometer Maxima. I. Factors Causing Asymmetry by Leroy Alexander J Applied Phys 19 1068-1071 (1948) Nov

The observed asymmetry of x-ray spectrometer maxima arises principally from three-dimensional properties of the ideally two-dimensional focusing arrangement employed, vertical divergence of the primary beam being the fundamental cause. A mathematical formula is developed which expresses the degree of asymmetry as a function of the reflection angle and the geometrical properties of the apparatus. The asymmetrical effects predicted in this way qre qualitatively confirmed with experimental measurements. Practical suggestions are made for minimizing asymmetry. Illustrative schematic diagrams are given, along with curves showing the effects of slit height and diffraction angle on the symmetry of quartz maxima.

325 Infrared Prism Spectrometry for 24 to 40 Microns by Earle K Plyler J Research Natl Bur of Standards 41 125-128 (1948) Aug

A prism of KRS-5 (thallium-bromide-iodide) has been used to measure the transmission of various substances in the infrared region from 24 to 40 microns. The prism was installed in a Perkin-Elmer spectrometer, and a Golay detector was employed for measuring the energy. Transmission data were obtained for polystyrene, polyethylene, and different samples of KRS-5. Also measurements have been made on the cut-off of KBr, AgCl, and other crystals. The rotational spectrum of the water-vapor molecule has been measured to 39.2 microns, and the known frequencies of these absorption bands have been used for the calibration of the prism.

326 Isotope Effect in the Spectrum of Ne II by K Murakawa and S Suwa Phys Rev 74 1535-1536 (1948) Nov 15 (Letter to the editor)

Tabulated data of the isotope effect observed in the spectrum of Ne II obtained in a hollow cathode aluminum tube discharge in Ne at a pressure of a few mm of Hg are given. The interference pattern observed for the 3378 and 3393A lines, taken with a 4.4 mm quartz Lummer plate, is shown. A distinctly larger isotope effect was observed for the doublet system of the combination $3s(^3P) - 3p(^3P)$ than for the quartet system of the same combination; this is analogous to results which have been obtained for MgI (Mundie and Meissner, Phys Rev 65 265 (1944)).

SPECTROSCOPY (continued)

327 Microwave Spectra of Some Linear XYZ Molecules by C H Townes, A N Holden and F R Merritt Phys Rev 74 1113-1133 (1948) Nov 1

Measurements of the pure rotational spectra of a number of isotopes and vibrational states of OCS, ClCN, BrCN, and ICN near one centimeter wave-length have been made. Experimental techniques used and interpretation of the spectra of linear XYZ molecules are discussed. Schematic circuit diagrams and spectra obtained are shown. The detailed tabular data given include frequencies and intensities of lines and comparison with theoretical values, rotational constants B_0, rotation-vibration constants α, l-type doubling constants, internuclear distances, half-width parameters of lines, quadrupole coupling constants, and nuclear quadrupole moments. Agreement between experimental results and available theory is good in all cases except for the values of l-type doubling constants.

328 The Microwave Spectrum of Carbonyl Selenide by M W P Strandberg, T Wentink Jr and A G Hill. MIT Research Laboratory of Electronics Technical Report 78 (Army Signal Corps Contract) June 21 1948 15p (NP-455)

The microwave absorption spectrum of carbonyl selenide, OCSe, is reported. The expected linear structure is confirmed. The spectrum includes absorptions due to various isotopic forms of the molecule in the aero-point vibrational state and the first excited symmetrical stretching and bending vibrational states. From these data vibration-rotation interaction coefficients, mass differences and approximate interatomic distances have been determined. Values for the nuclear spins of the six stable selenium isotopes are suggested. Observations of the Stark effect lead to a determination of the dipole moment of the molecule in several vibrational states. Intensity measurements are used to determine vibrational frequencies and relative isotopic abundance.

329 On the Configurations d^2sp, d^3p, and d^7p by F Rohrlich Phys Rev 74 1372-1380 (1948) Nov 15

The energy matrices of the configurations d^2sp, d^3p, and d^7p are calculated in terms of Slater's F^k and G^k integrals (Phys Rev 34 1293, 1929) for Russell-Saunders coupling using Racah's method of tensor operators (Phys Rev 61 186 (1942); 62 438 (1942); 63 367 (1943)).

330 Some Preliminary Results on the Spectra of AsH_3, AsD_3 and PH_3 by Virginia Marie McConaghie and Harald H Nielsen. Proc Natl Acad Sci 34 455-464 (1948) Sept

Some of the measurements which have been made on several of the bands in the spectra of AsH_3, AsD_3, and PH_3 are summarized. Absorption spectra are shown for AsD_3 in the infra-red and the 3020 cm^{-1} regions, for AsH_3 in the infra-red, the 4160 cm^{-1}, and 1800 cm^{-1} regions and for PH_3 in the infra-red region. Tabulated data on the two arsenic compounds are given on band frequencies, normal frequencies, rotational constants, and molecular dimensions.

331 The Zeeman Effect in Microwave Molecular Spectra by C K Jen Phys Rev 74 1396-1406 (1948) Nov 15

A microwave cavity spectroscope is described, which possesses a high sensitivity and resolution for the observation of the Zeeman effect of molecular absorption lines in the microwave frequency range. The theory of operation for this spectroscope and the criteria for sensitivity are formulated. The Zeeman effect of a number of microwave spectral lines has been measured for the gas molecules $N^{14}H_3$, $N^{15}H_3$, and CH_3Cl^{35} and observed for CH_3Cl^{37} and SO_2. All the experimental results obtained so far can be satisfactorily explained by the combined magnetic contribution due to nuclear and molecular g factors, if there exists a spin-rotation coupling, or solely by the magnetic contribution due to molecular rotation, if there is no such coupling. Thus, further knowledge of the nuclear and molecular magnetic properties of molecules can be obtained through the examination of the Zeeman effect in microwave absorption spectra.

TRACER APPLICATIONS – BIOLOGY

332 The Application of the Isotope Technique to the Study of the Rates of Formation of Blood Constituents in Man by Irving M London, David Shemin and D Rittenberg J Clin Invest 26 1188 (1947) Nov

The feeding of glycine labeled with N^{15} to humans results in the incorporation of N^{15} in the serum proteins and the heme of red blood cells as well as in other body constituents. Glycine is the nitrogenous precursor of the protoporphyrin of hemoglobin. The N is incorporated in the red blood cell during the deposition of hemoglobin, and the labeled porphyrin remains in the cell until the cell disintegrates. The porphyrin is not subsequently reutilized for hemoglobin synthesis. Accordingly, the isotope technique affords a unique method for studying the kinetics of red cell formation and for determining the average life span of the human red cell. This life span has been found to be 127 and 128 days in two normal adult men. Data on the rates of generation and on the life span of red cells in a patient with pernicious anemia and in another with polycythemia vera have been obtained which may clarify certain factors in these disease processes. Serial measurements of N^{15} concentration in electrophoretically separated fractions of serum proteins have yielded information on the relative rates of elaboration of these proteins. Correlative studies of N^{15} concentration in urinary urea, ammonia, and uric acid have provided further information on protein and purine metabolism.

333 Basic Concepts of Soil and Fertilizer Studies with Radioactive Phosphorus by S B Hendricks and L A Dean In Symposium on the Use of Radioactive Isotopes in Soil and Fertilizer Investigations p 98-100. Geneva, New York, Soil Science Society June 1 1948

Methods of preparation and properties of radioactive phosphorus of mass 32 are discussed. Sensitivity of detection of P^{32} at extremely low concentrations and quantitative determination of dilution by change in specific activity make possible new types of experiments on reactions of phosphates with soils and uptake of fertilizers by plants. 8 references.

334 [Bibliographies by T H Oddie]. Australian Council for Scientific and Industrial Research, Sept 15 1947-Mar 22 1948 (NP-474-NP-495, incl)

No. 1 – Applications of Radio-Elements to Metallurgical and Industrial Problems.
No. 2 – Use of Radio-Isotopes for Blood Disorders.
No. 3 – Use of Radio-Isotopes for Blood Disorders. (Supplement to No. 2)
No. 4 – Application of Radio Isotopes to the Thyroid Gland.
No. 5 – Application of Radio-Isotopes to the Thyroid Gland. (Supplement to No. 3)
No. 6 – Applications of Radioelements in General Biology, Bacteriology and Bacteriology, and Parasitology.
No. 7 – Use of Radioelements in Botany and Agriculture.
No. 8 – Use of Radioelements in Zoology.
No. 9 – Use of Radioelements for Study of Blood, Circulation, and Respiration.
No. 10 – Radioelements in Absorption and Nutritional Investigations.
No. 11 – Applications of Radio-Isotopes in Biochemistry.
No. 12 – Use of Radio-Isotopes in Chemistry.
No. 13 – Use of Radio-Isotopes in General Pathology and Cancer.
No. 14 – Radioelements in the Study of the Digestive, Excretory, and Glandular Systems.
No. 15 – Radioelements in Hygiene, Toxicology and Pharmacy.
No. 16 – Study of B one with Radioelements.
No. 17 – Therapy with Artificial Radioelements.
No. 18 – Study of Teeth and Saliva with Radioelements.
No. 19 – Radioisotopes in Embryology.
No. 20 – Study of Muscle with Radioelements.
No. 21 – Application of Radioelements to Brain, Nerve, and Sense Organs.
No. 22 – Stable Isotopes in Absorption and Nutritional Investigations.

TRACER APPLICATIONS – BIOLOGY (continued)

335 Concentration of Radioactive Iodine by the Thyroid Gland of the Parrot Fish, Sparisoma Sp. by Samuel A Matthews and Dietrich C Smith Amer J Physiol 153 222-225 (1948) May 1

The thyroid gland of the parrot fish, Sparisoma, unlike that of most teleosts, is a compact one, but some thyroid follicles also seem to be present in the vicinity of the gills. That it concentrates radioactive iodine as do the thyroids of higher vertebrates was determined by injecting each fish with doses varying from 0.8 to 2.5 cc of I^{131} (between 2.6 and 8.3 microcuries), killing them after intervals of 6, 12, 24, and 48 hours, and preparing autoradiographs of the thyroids, auricles, and pieces of gill. The extent to which the gland concentrates this material under different seasonal and experimental conditions can now be studied by the quantitative methods available for measuring such radioactive isotopes.

336 Cytochrome C Labeled With Radioactive Iron by Helmut Beinert and Heinz Maier-Leibnitz Science 108 634 (1948) Dec 3 (Comments and Communications)

In what the authors believe may be the first attempt to tag hemoproteins related to hemoglobin, iron-depleted young rats were given radioactive iron of high specific activity (Fe^{55}). The total dose was about 11 mg, but no deleterious effects were observed and lactation and reproduction seemed undamaged. Cytochrome C showing an activity of 1,235 ± 9 cpm for 1 mg of pure cytochrome C on a molecular-weight basis of 13,000 was isolated from heart and skeletal muscle tissue according to the method of Keilin and Hartree (Proc Roy Soc London, B122 298 (1937)).

337 Determination of the Relative Activities of Antithyroid Compounds in Man Using Radioactive Iodine by M M Stanley and E B Astwood Endocrinology 41 66-84 (1947) July

By giving doses of I^{131} to normal volunteers and measuring the concentration in the gland by a Geiger counter applied to the surface of the neck the rate of iodine uptake by the thyroid was measured. During the period of absorption the concentration rose slowly and then rapidly and parabolically to reach a constant level after 24 to 48 hours. The parabolic part of the rise became a straight line for its first 8 hours when plotted on a square-root time scale, though the slope of the line varied individually. The slope for any individual was established 1 to 2 hours after the radioactive iodine was ingested, and if an antithyroid drug was then given the uptake of iodine was interrupted and the activity of the drug could be graded according to the degree and duration of the interruption. Thirty-two compounds were tested in doses of 5 to 500 mg. The results obtained did not agree with the results of determinations of thyroid enlargement in rats caused by the drugs.

338 The Distribution of Phosphorus^{32} in Early Chick Embryos by Ernest L Hunt and Jerome J Wolken J Exptl Zool 109 109-118 (1948) Oct

Phosphorus^{32} was introduced into the white of 302 hen's eggs at 0, 24, and 48 hours of incubation. The resulting embryos were removed approximately 24 hours after injection and auto-radiographs made on Eastman No-Screen X-ray Safety film. Seventy-two resulting radiographs from 18 to 80 hours were used in this study. Observations of these auto-radiographs indicated that phosphorus^{32} (and thus non-radioactive phosphorus) tended to be distributed in certain patterns: With some exceptions, a striking concentration in rapidly developing and differentiating organs appeared when or very shortly after these organs started to develop. An anteroposterior gradient appeared at about 20 hours and remained through at least the 60-hour stage. A secondary center of distribution in the posterior regions of the embryo appeared at the stage when the tail bud started its development. To a lesser extent a mesiolatheral gradient appeared in later stages. The patterns of phosphorus distribution can be correlated with the findings of other workers on phosphatase distribution, oxygen uptake, metabolic activity, and parallel to a considerable extent the distribution of copper. 4 references.

TRACER APPLICATIONS – BIOLOGY (continued)

339 Human Plasma Phospholipid Formation: A Study Made with the Aid of Radiophosphorus by William M Balfour Gastroenterology 9 686-694 (1947)

Sodium phosphate containing P^{32} was given intravenously or orally to fasting subjects, 20 patients with various types of diseases and 9 normal men, in doses providing 2 microcuries of radioactivity per kg body weight in this study on phospholipid production in various types of hepatic diseases with and without hyperlipemia. Fasting blood samples were drawn after 24, 48, 72 and 96 hours. It was found that the level of the plasma phospholipids was a measure of the new phospholipid being formed and that if the level is high, there is an overproduction of the phospholipid by the liver rather than a piling up due to biliary obstruction or decreased breakdown of the phospholipid molecule by the tissues. This has been found to be true in all the pathologic states studied no matter what the cause of the hyperlipemia. 17 references, 3 figures, and 1 table.

340 Isotopic Carbon by Melvin Calvin, Charles Heidelberger, James C Reid, B M Tolbert and Peter Yankwich. New York, John Wiley and Sons Inc early 1949 approximately 349p

This book, dealing exclusively with the isotopes of carbon, makes a good laboratory manual for people who want to eliminate gathering data from scattered sources.

341 Medical Aspects of Artificial Radioactivity by Charles M Barrett and Benjamin Felson Cincinnati J Med 29 610-615 (1948) Nov

The use of radioactive isotopes in medicine and research is reviewed here. A table of 23 radioactive tracers in biology and medicine and their half-life and type of radiation is given. 14 references.

342 The Metabolism Studied by Means of the Radioactive Isotope Zn^{65} by Bert L Vallee and Rex G Fluharty. J Clin Invest 26 1199 (1947) Nov

External scanning with a gamma ray Geiger-Müller counter has shown that, following intravenous administration, Zn^{65} becomes widely distributed throughout the entire body of the normal dog. The normal range of zinc content of organs has been determined in normal dogs by an improved dithizone method. The ranges, in completely perfused organs, in gamma per gram (wet weight), are: heart and great vessels 15-20; respiratory organs 10-20; digestive organs 10-60; genito-urinary tract 20-50; muscle 40-50; cortical bone 40-50; C.N.S. (brain) 10-15; endocrines 20-100; lymph glands 15-100; liver 50-60; spleen 10-20; marrow 60-80; plasma 2-4 (per cc); whole blood 7-9. Simultaneous measurements of Zn^{65} and total zinc content have not shown selective localization of the element in any of the above organs.

The complete separation of white cells from blood can be effected by floatation of heparinized whole blood on an isosmotic solution of bovine serum albumin of specific gravity of approximately 1.079. The normal zinc content of white cells is 1×10^{-2} gamma and of red cells 1×10^{-4} gamma per million cells, respectively. Following the intravenous injection of Zn^{65} the isotope becomes concentrated within the circulating white cells in amounts sufficient for accurate x-ray detection in the leucocyte mass separated from 15 cc of whole blood (1.0 to 2.0×10^8 whole blood cells).

Blood, white cells, and tissue samples are dry ashed, and the zinc extracted with dithizone for colorimetry. The zinc is removed from the dithizonate with sulfuric acid and electroplated from an alkaline solution with added carrier zinc on a copper disk. The x-ray counting procedures are similar to those used to measure Fe^{55}. These procedures have opened the way to a study of overall zinc metabolism in addition to the physiology of leucocytes.

343 Radioactive Iodine as a Diagnostic Aid for Intrathoracic Goitre by G Ansell and J Rotblat Brit J Radiology 21 552-558 (1948) Nov

The application of the radioactive tracer method to the diagnosis of intrathoracic goiter has been investigated using radioactive iodine and detecting its γ-rays by the "in vivo" technique. A special apparatus was constructed which makes it possible to map out the area in which the radioactive

TRACER APPLICATIONS – BIOLOGY (continued)

material is contained. A case of intrathoracic goiter is described in which this technique has been used successfully. 18 references.

344 Radioisotopes in Nutritional Trace Element Studies — III by C L Comar Nucleonics 5 34-48 (1948) Nov

This is a review of the experimental investigations based on the use of radioisotopes of the nutritional trace elements, copper, molybdenum, and zinc, as they affect plant and animal nutritional diseases. 43 references.

345 Some Tracer and Therapeutic Studies with Artificial Radioactivity, Sir James Mackenzie Davidson Memorial Lecture by John H Lawrence Brit J Radiology 21 531-543 (1948) Nov

This is a general review of the subject. There are 27 references, 9 figures, and 3 tables.

346 Use of Radioactive Sodium as a Guide to the Efficacy of Drugs Used in Treatment of Diseases of the Peripheral Vascular System, Preliminary Report by Isidor Mufson, Edith H Quimby and Beverly C Smith Amer J Med 4 73-82 (1948) Jan

In the treatment of peripheral vascular diseases the objectives are the reopening of completely or partially closed blood vessels and the development of an adequate circulation. A preliminary report is made of the use of radioactive sodium as a guide to the efficacy of papaverine hydrochloride and histamine which have been reported as useful. The authors' conclusions are as follows: Patients with scleroderma, thrombo-angiitis obliterans, obliterative arteriosclerotic endarteritis and non-specific arteritis of the minute vessels show a subnormal curve for the diffusion of radioactive sodium from the blood vessels. Histamine administered by iontophoresis or by intra-arterial injection brought about a definite rise in the diffusion curve. When given intravenously in one patient it produced the opposite effect. The dilatation caused by histamine was not reversed by 1:250,000 adrenalin given intravenously. Neither papaverine nor 5 per cent sodium chloride solution given intravenously produced changes in the radioactive sodium curves. Of the drugs tested, only histamine appeared able to produce an immediate increase in the capillary diffusion rate as determined by a radiosodium curve taken following a single dose. A method for giving an intra-arterial infusion is described. To date ninety such infusions have been administered.

347 The Use of Radioactive Tracers in Plant Nutrition Studies by P R Stout, Roy Overstreet, Louis Jacobson and Albert Ulrich. In Symposium on the Use of Radioactive Isotopes in Soil and Fertilizer Investigations p 91-97 Geneva, New York, Soil Science Society June 1 1948

In reviewing the applications of radioactive isotopes to studies in soils and plant nutrition, examples of several types of applications have been taken from work done in the Division of Soils and Plant Nutrition at the University of California.

Methods of detection and their level of sensitivity are discussed. General topics illustrated with experimental work are the following: direct tracing of gross transport of salts in living systems; general applications of "tracer chemistry"; autographic techniques; micronutrient element studies with radioisotopes of high specific activity; application of radioactive tracers to fertilizer studies; exchange reactions; special role of radioactive carbon in plant and soil studies; and studies with fission products.

The work discussed involved the use of 19 different radioelements. Of these elements, N, C, P, S, K, and Zn are physiologically required elements for the growth and development of plants. Na, Rb, Cs, Sr, Br, and I have been used as analogues of important ionic types of importance to plant and soil chemistry, and Y, Ce, Cb, Te, Zr, and Pu have been investigated as fission products. 15 references.

TRACER APPLICATIONS – CHEMISTRY

348 The Use of Radioactive Isotopes for Experimental Study of the Reactivity of Aromatic Compounds. I. Analyses of the Isotopic Exchange of Halogen between Mineral Bromides and Aromatic Bromides by Paul Rumpf and Bernard Pullman Bull Soc Chim France No. 1-2 173-178 (1948) Jan - Feb (In French)

The authors report on their preliminary work, which taught them some detailed techniques with regard to the isotopic exchange of halogens in organic chemistry in the preparation of radioactive copper and potassium bromides and radioactive antimony and aluminum. The destruction of organic matter in an especially developed lamp and the filtration of fumes and absorption of hydrobromic acid are described. In the case of bromobenzene and α-bromonaphthalene, passage of radioactive bromine, always accompanied by secondary reactions, was observed between 16° and 200°C only for anhydrous aluminum bromide. Increasing the quantities of solvents such as benzene or nitrobenzene simultaneously diminishes and suppresses the two phenomena. Previous work on the subject is covered and drawings of apparatus used are given, as are tables of the results on the organic and mineral halides. 23 references.

TRACER APPLICATIONS – INDUSTRY

349 Tagged Atoms Offer a New and Amazing Research Tool by William B Dall Textile World 98 No. 12 103-104 (1948) Dec

The author presents a few of the elementary concepts of nuclear physics in a discussion of the use of "tagged" atoms. In particular, some applications currently being used in the textile industries are discussed.

350 Tracer Study of Sulphur in the Coke Oven by S E Eaton, R W Hyde and B S Olds Metals Technol 15 Tech Pub No 2453 (1948) Oct 20p

Radioactive tracers were used to determine the principal sources of sulphur in coke. Sulphur exists in coal as pyritic, organic, and sulfate sulphur. The experiment was designed to indicate how much pyritic and, by difference, how much organic and sulfate sulphur remain in the coke after carbonization. It was hoped that the results would serve as a guide in the selective purchasing of coal to produce a low sulphur coke. In general, there is no satisfactory way, using present coking methods, to reduce the sulphur content of coke by choosing coal of high or low pyritic or organic sulphur. The results of the experiment indicate that the pyritic and organic sulphur appear in coke in proportion to their concentration in the coal. In view of the large initial evolution of organic sulphur observed in the experiment, coals containing large amounts of organic sulphur and small amounts of pyritic might be coked for a slightly shorter time to produce coke containing a given percentage of sulphur. Coals high in pyrite sulphur would have to be coked for a slightly longer period of time to obtain the same results.

TRANSURANIC ELEMENTS

351 Fission of Atomic Nuclei. Part I. Transuranium Elements by B C Purkayastha Nucleonics 3 No. 5 2-21 (1948) Nov

Present knowledge of the transuranic elements, i.e., elements of atomic number greater than 92, is reviewed in the first of a series of articles on nuclear fission. The isotopes of Np, Pu, Am, and Cm are discussed and a table of nuclear reactions and isotope properties for elements of atomic number 92-97 is given. The techniques of ultramicrochemistry useful in working with unweighable amounts of radioactive substances are summarized special pipettes, scales, and balances are described. The author concludes with a discussion of the electronic structure of the actinide series. Tabulated data of the electronic composition of typical levels for the various elements are given, and the significance of these data in terms of the chemical properties of the different elements is noted. 50 references.

URANIUM

352 Chemistry of Aqueous Uranium (V) Solutions. II. Reaction of UCl_5 with Water. Thermodynamic Stability of UO_2^+. Potential of U(IV)/(V), U(IV)/(VI)^5 and U(V)/(VI) Couples by K A Kraus and F Nelson. AECD-2394 (ORNL-189) Nov 10 1948 Decl Dec 3 1948 27p For proposed publication in J Amer Chem Soc

Aqueous solutions of UCl_5 were examined polarographically and simultaneously their acidity was measured with a glass electrode assembly. It was found that near pH 2 U(IV) and U(VI) are the primary solution products and that these oxidation states can react with each other to yield appreciably concentrations of U(V) $(UO_2)^+$ in equilibrium with U(IV) and U(VI). From potential measurements of such equilibrium mixtures the formal potentials of the U(IV)/(V), U(V)/VI) and U(IV)/(VI) couples near pH 2 were calculated. From combination of these data with the various hydrolytic data the formal potentials of these couples in 1M $HClO_4$ were estimated. The pH measurements were in agreement with the assumption that the ionic species of U(IV), U(V), and U(VI) near pH 2 in 0.1M Cl are primarily UOH^{+3}, and UO_2^+, UO_2^{++}.

353 Ammonium Thioglycolate as a Colorimetric Analytical Reagent for Uranium (VI) in the Presence of Various Anions by W H Davenport Jr and P F Thomason. AECD-2398 (ORNL-161) Aug 1 1948 Decl Dec 1 1948 12p Proposed for publication in Analyt Chem

In an investigation of conditions affecting the determination of iron with ammonium mercaptoacetate (thioglycolate), it has been previously reported that uranyl ions formed a strong orange complex with the reagent. Anions had little effect on the iron thioglycolate color. This suggested the possibility that the reagent might be used for the colorimetric determination of uranium in the presence of various anions. Hexavalent uranium forms a yellow-orange soluble complex with ammonium thioglycolate in a basic solution. The color intensity remains constant over a wide pH range and is independent of the exact reagent concentrations. The complex is fairly stable and unaffected by many of the common anions. A number of cations interfere either by reacting with the reagent or by precipitating in ammoniacal solutions. Some of these interferences may be eliminated by the use of excess reagent or complexing agents. The method is best suited to the determination of uranium in the concentration range 0.100 - 1.600 mg. in 25 ml. Solutions containing uranium in this range obey Beer's Law.

354 Szilard-Chalmers Process for Uranium by D S Breslow and J W Hamaker. AECD-2409 (A-174) Apr 13 1942 Decl Dec 8 1948 5p Document for sale by AEC

The development of a Szilard-Chalmers procedure for the concentration of U^{239} and U^{237} is reported. A procedure with organic uranium compounds in which the activated uranium is expelled from an organo-uranium compound during the interaction of the neutron with the uranium atom is described. The organic compound used is salicylaldehyde-o-phenylene-diamine uranyl complex. It is prepared in two steps: salicylaldehyde is condensed with o-phenylenediamine in hot ethyl alcohol, and the resulting complex is then condensed with uranyl acetate in the same solvent. The resulting compound is then recrystallized from pyridine. Because of the inconvenience of using pyridine a modification in the method was made which would eliminate the use of this substance.

355 The Preparation and Properties of Uranium Trifluoride by J C Warf. AECD-2413 nd Decl Oct 29 1948 15p For publication in NNES

The means of preparing uranium trifluoride are discussed. The most practical method found is the reduction of uranium tetrafluoride with uranium although reduction with hydrogen or atomic hydrogen may also be feasible. In the first case a uranium-uranium tetrafluoride mixture is treated with hydrogen at 250°C when the uranium is broken down into powder, uranium hydride. This permits intimate mixing with the uranium tetrafluoride. The mixture is heated, decomposing the uranium hydride raising the temperature to 1000-1100°C completes the reaction. The uranium trifluoride thus formed

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is a black, coke-like solid. A literature survey and discussion of other means of preparation are given. X-ray diffraction patterns were taken and the structure of the trifluoride established. The compound is hexagonal, $a_1 = 4.13$ A, $a_3 = 7.33$ A. Heating to 1600°C was found to disproportionate the substance into uranium tetrafluoride and uranium, the first of which sublimed while the latter reacted with the crucible. The chemical properties of the trifluoride were investigated and tabulated. The compound may be reduced to uranium metal by calcium, using a bomb technique, giving smooth compact metal. 21 references.

356 Determination of Uranium in Uranyl Salts by J Sutton. National Research Council, Canadian Atomic Energy Project NRC 1591 1945 2p

By electrolytically reducing the UO_2^{+2} sulfates, chlorides, and perchlorates to U^{+4} and then titrating back to UO_2^{+2} using $Ce(SO_4)_2$ in the presence of o-phenanthroline-Fe^{+2} complex indicator, the uranium content may be determined. By drawing air through the solution for 5 min. before titration, any U^{+3} formed is oxidized.

357 Spectrographic Detection of Trace Amounts of Uranium. Determination of Uranium in Manganese Dioxide by J E Currah, F E Beamish, W F Allen and J C Bartlet. National Research Council, Canadian Atomic Energy Project, NRC 1628 1945 5p

A method for the determination of uranium in MnO_2 is given in detail. Five grams of the sample are dissolved in HNO_3 + 30% H_2O_2, heated to destroy the excess H_2O_2, and then extracted with 10 cc of hexone. After draining off the aqueous layer, another extraction with 10 cc of hexone is performed. To the extracts 3 cc of HNO_3 and 5-6 glass beads are added and the solution heated for about 30 sec, (Caution: hexone-HNO_3 may explode) igniting the evaporating hexone. Heating is then continued until a black charred mass is obtained. Three cc of concentrated H_2SO_4 is then added and heated to fumes. After cooling, concentrated HNO_3 is added dropwise and the acid evaporated, after which it is taken up in a little water. The solution is then filtered, evaporated to 0.1-0.3 ml and transferred to the silver bottom electrodes, examining the U line at 4543.6 A. Traces of U may be detected by means of the silver bottom electrodes, comparing the 4090.1 and 4543.6 A lines with those of known samples. Spectra are shown.

358 Critical Study of the Reactions of Cations. Part IV. Uranium by Thérèse Duval and Clément Duval Analyt Chim Acta 2 313-315 (1948) Sept (In French)

The best drop method for uranium analysis during the period 1937-1947 was reported in the Deuxième Rapport (Redaction P Wenger et R Duckert), Wepf et Cie, Bale 1945 English edition, Elsevier Publishing Co., New York-Amsterdam 1948. This was the microscopic examination of crystals formed by anthranilic acid in a saturated solution. The lower limit is 0.01 γ, and the analysis may be performed in the presence of copper and iron. For the Fourth Report, only the micro-chemical reaction given by an alkaline thiocyanate and sparteine, even in the presence of large excess of iron, will be retained. This method is described.

359 Gravimetric Analysis of Uranium (A Study of the Precipitate Using Chevenard's Thermobalance) by Clement Duval Compt Rend 227 679-681 (1948) Oct 4 (In French)

The author undertook a critical study of all procedures for uranium analysis (valences 4-6) to see if the best conditions for calcination of the precipitates could be stated, and to see if certain methods would be suitable for automatic analysis. Sixteen reagents, the formulas of the corresponding precipitates and the allowable temperatures for calcination or drying are listed. The methods using HF, cupferron, and oxalic acid can only be applied to U IV and permit the estimation of U VI. Precision is the same in all three methods, but the oxalic acid is the most practical one. Weighing of the oxalate is done in the 100°-180° range. Of the three methods using oxime, β-isatoxime, quinaldinic acid, oxime is the most precise, practical, and economical. In this case, the precipitate loses one molecule

URANIUM (continued)

of oxime from 157°-252°, leaving the new $(C_9H_6ON)_2UO_2$, stable from 252-346°. Thus, it is possible to filter, dry, and weigh the precipitate in one hour, and to apply the method for the automatic determination of U. By using ammonia in the presence of ammonium nitrate, U_3O_8 is obtained between 745°-946° and dissociation starts at 946°. Precipitation of pyrouranate (by employing ethylene diamine) does not offer any advantages over pyridine. There is an appreciable difference between tannin, hexamethylene tetramine, and ammonium benzoate. Mercury oxide is not suitable at all. Using a slow current of air, charged with ammonia gas, following Trombe's method (Compt Rend 215 539 (1942)), gives satisfactory results, as far as the formation and immediate washing of the precipitate starting from pH 3.8 is concerned. Weighing in the form of the peroxide is good, infra red absorption showing that UO_42H_2O should be written as $UO_3.H_2O.H_2O$. Measuring in the form of sulfur, phosphate, and vanadate causes difficulties and is not as precise as other methods.

360 Inorganic Chromatographic Adsorption (Adsorbimento Cromatografico Inorganico) by Luigi Sacconi Gaz Chim Ital 78 583-591 (1948) Aug (In Italian)

The chromatographic behavior of the following ions was studied, Ti^{4+}, U^{4+}, Ti^{3+}, and Ce^{3+}, and their separation from the major part of the other ions performed. The experiments reported prove that the "basic" adsorption of many of the cations is not due to the alkalinity of the alumina but rather due to a specific action of the alumina itself.

361 Method of Extracting Uranium, Radium, and Vanadium from their Ores by Ralph D Nye and Dana J Demorest. U. S. Patent 2,442,429 May 4 1946

A method of treating ores containing uranium, vanadium and radium is described. The ores are reduced mechanically to a relatively fine divided state, and the reduced ores are treated with a solution of an alkali carbonate. Heat and agitation are used to insure the complete dispersal of the radium and uranium. The treated ores and solutions are washed with upward flowing currents of water to separate the solution and suspended fines and floating slimes from a residue of coarse sand grains. The washed solution and its fines and slimes are treated with an acid sulphate until the solution is rendered acid. A solution of a metallic salt is then added to precipitate and insoluble sulphate form of the metallic component of the salt and to take suspended fines and slimes out of solution and thereby leave a clear supernatant solution and a sludge precipitate. The clear supernatant solution is separated from the precipitate mechanically. The supernatant solution is then treated with a caustic alkali base to precipitate concentrations of uranium, radium and vanadium compounds and to produce a basic alkali solution. The basic solution is reactivated for re-use in the washing of the treated ores. The sludge precipitate is combined with the residue of coarse sand grains for further concentrations of the remaining vanadium content by salt roasting.

362 A New Organic Uranium Compound by Stewart J Lloyd and Mason C Cleere Science 108 565 (1948) Nov 19

By mixing 100 cc of an alcoholic solution of anhydrous uranium acetate and 80 cc of an alcoholic solution of hexamethylenetetramine under proper conditions a new compound is formed which shows needle-like crystals, decomposes at 185°C, is soluble in glacial acetic acid and insoluble in alcohol. The analysis gives U, 46.3 and N, 9.7.

363 On the Discovery of Uranium Fission by Otto Von Hahn Experimentia 369-373 (1948) Oct 15 (In German)

A description is given of the studies of Lise Meitner and Fr. Strassmann from 1935-1938 on the products observed after the irradiation of uranium with neutrons.

Full details are given of the experiments which led Hahn and Strassmann to the discovery of the fission of uranium. In the conclusion the researches pursued at the Kaiser Wilhelm Institute for Chemistry in Berlin-Dahlem from 1939-1944 are mentioned briefly.

URANIUM (continued)

364 Purification of Uranium Oxide by James I Hoffman J Wash Acad Sci 38 233-236 (1948)

By evaporating a nitric acid solution of impure oxides to dryness on a steam bath, extracting the residue with ether and washing with water the author obtains uranyl nitrate. Heating this compound to 1000° yields U_3O_8. The procedure is applicable to other elements, particularly those of the rare earth group, and to pitchblende and carnotite.

365 A Spectrochemical Method for the Determination of Uranium by L T Steadman. Abstract in Analyt Chem 20 1127 (1948) Nov (Paper presented at 33rd Meeting of the Optical Society of America Oct 21-23 in Detroit)

Microgram amounts of uranium are analytically determined by means of the Bausch and Lomb medium quartz spectrograph. The sample is placed in the negative electrode, burned in the crater of a purified graphite rod or arced on the flat end of a carbon electrode, and the relative intensities determined by a sector method employing a rotating half-cylinder in front of the slit. A 10 mg addition of rubidium chloride increases the sensitivity 50-fold. A standard error of ±15% is inherent.

366 The Surface Tension and Viscosity of Solutions of Uranyl Salts by W E Grant, W J Darch, S T Bowden and W J Jones. J Phys and Colloid Chem 52 1227-1236 (1948) Oct

The surface tension and viscosity of solutions of uranyl nitrate hexahydrate, uranyl acetate dihydrate, and anhydrous uranyl acetate in water and in methanol have been measured at a series of temperatures from 0°C to the neighborhood of the boiling point of the solvent. The surface tension of water is raised by uranyl nitrate but is lowered by uranyl acetate. The surface tension of methanol is raised by uranyl nitrate hexahydrate, by uranyl acetate dihydrate, and slightly by anhydrous uranyl acetate. The Bugliginsky equation applies to aqueous solutions of uranyl nitrate and methanol solutions of uranyl acetate dihydrate, but the Freundlich relation is in better accord with the results for methanol solutions of uranyl nitrate hexahydrate.e.

The viscosity of water is increased by uranyl nitrate, but is little influenced by uranyl acetate. Uranyl nitrate hexahydrate and uranyl acetate dihydrate increase the viscosity of methanol, but the anhydrous acetate has only a slight effect. Equations of the Jones-Talley type are found to be applicable over the range of concentrations studied, but here the constants are purely empirical. Calculations by means of the Falkenhagen-Dole-Vernon expressions are not possible even for the aqueous solutions, owing to the complexity of the ionization and the incidence of hydrolytic reactions. 31 references.

367 Tetravalence of Uranium in the Uranyl Compounds and Other Uranium Compounds (Tetravalencia del Uranio en las Combinaciones de Uranilo y Otros Compuestos de Uranio) by G E Villar Anal Asoc Quim Argentina 36 5-18 (1948) Mar (In Spanish)

The work presented attempts to support the hypothesis that uranium also has a normal valence of four and that it behaves like a tetravalent element in its oxides and in the uranyl compounds, uranates, and polyuranates. If this be the case, then the uranyl radical would have the structural formula $\overset{O}{\underset{O}{}}U=$ and the formulas of all known uranyl compounds and uranium compounds could be based on the tetravalence of uranium.

VACUUM

368 Leak Detection Instruments and Techniques (Vol I, Chap V) by R Loevinger and A Guthrie. AECD-2405 (BP-93) nd Decl Dec 6 1948 74p For publication in NNES

The locating and repairing of leaks in vacuum systems is probably the most troublesome aspect of high vacuum technique. In this chapter is given first a rough method of estimating the flow of various gases through small capillary holes, then a description of all the successful methods of leak detection normally available and finally an indication of the method of formulating quantitatively the

VACUUM (continued)

performance of leak detection techniques. Information is submitted concerning the flow characteristics of small capillaries, methods of leak detection, pump-outs, the vacuum analyzer, the helium leak detector, general leak hunting procedure, repairing of leaks,outgassing, virtual leaks, and theory of leak detection. 19 references.

369 Ionization Gauge Metering Circuit by Carl A Hermanson Northwestern Eng 7 No. 4 20-21, 40, 42 (1948) Dec

A non-technical summary of major existing types of vacuum gages is presented. After evaluating the limitations of the other gage types, the author discusses the merits of the ionization gage and the characteristics of the associated metering circuit.

370 A Stable Pirani-Gauge Circuit for Indication and Control of Vacuum Equipment by C M Schwartz and R Lavender Rev Sci Instruments 19 814-815 (1948) Nov

A stable Pirani-gage circuit for measurement of pressures in the 1-100 micron range is described and circuit diagrams are shown. The circuit was designed for use in several vacuum systems, in some of which it was desired to use the gage as a forevacuum detector whose signal would control other operations and, in particular, provide vacuum-failure protection. As an example of monitor application of this circuit, the use of one of these units with a vacuum evaporator is cited. In this case, the safety circuit both controls and protects the oil booster and diffusion pumps. The circuit has been found satisfactory in this and other applications.

371 Vacuum Manipulation of Volatile Compounds by R T Sanderson. New York, John Wiley and Sons Nov 1948 Approx 157p

The fundamental methods and apparatus involved in high vacuum technique are discussed. The author explains the construction and operation of a general purpose high vacuum system to be used in chemical research.